SCIENCE

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THE CARNEGIE INSTITUTION.

No doubt the officers of the Carnegie Institution fully realize the responsibility resting upon them and will refrain from making any considerable appropriations from the funds placed at their disposal until a well-defined policy, having the approval of the leading men in various departments of scientific research, has been adopted. I take it for granted that the officers and trustees are fully impressed with the importance of using the generous endowment placed in their hands in the most economical manner possible, having in view the objects to be attained—that is, they will aim to accomplish the greatest possible results with the means at their disposal. This will require very careful consideration and very exact knowledge of what is being done by other institutions and endowments for scientific research both in this country and in Europe. To go over ground that has already been well plowed or to undertake investigations for which there is already adequate provision would be a waste of money and of energy. The Carnegie Institution should not come into competition with any existing, well-directed agency for research work, but should be ready to lend a helping hand wherever it is needed for the prosecution of work already commenced or projected by competent investigators; otherwise it will, to a

certain extent, have a tendency to restrict scientific research in other institutions less amply endowed and having other uses for their money. So far as the national government is concerned, there can be no doubt that there would be a strong disposition to refuse or cut down appropriations for scientific work in the various departments if it was believed that the funds of the Carnegie Institution could be made available for such work.

In my opinion a considerable portion of the income should be used in assisting individuals who have demonstrated their fitness for research work in some special field of investigation, who have a definite object in view and well-considered plans for attacking the problem or problems which have engaged their attention. A certain amount of money may also be profitably devoted to the publication of scientific memoirs, and especially of those relating to research work done under the auspices of, or with the assistance of, the Carnegie Institution; also in assisting useful scientific periodicals which are not self-supporting. I would not encroach upon the capital of the Carnegie Institution for the erection of buildings or for any other purpose, but in my opinion a certain portion of the income should be devoted to the erection of a building in the city of Washington which would serve as 'headquarters' for officers and should be known as the 'Carnegie Institution.' This building should contain, in addition to the necessary offices, suitable rooms for the meetings of the various national and local scientific societies which meet in the city of Washington, including committee rooms, etc., also well-equipped laboratories for research work in physics, chemistry and biology.

In laying out the work and distributing available funds I trust that the executive committee will give due consideration to the claims of that branch of biology which relates to the health and well-being of man. No department of scientific research has given more important and brilliant results during the past quarter of a century than that which relates to the cause and prevention of infectious diseases, and there is still much work to be done in this field of investigation. Also in other lines of work which may be included under the general head 'hygiene.' In its broadest signification hygiene takes account of climate, soil, food, clothing, dwellings, occupations and social relations as related to the health and longevity of individuals, communities and nations. Here is a broad and fruitful field which has been partly illumined by the light of science with most beneficent results. But there are still many dark places where truth is hidden from our view or obscured by the acceptance of false conclusions based upon tradition or upon mistaken observation. While pure science may well be pursued without any regard for utility, it is nevertheless true that the most valued discoveries of scientific investigators are those which have led to practical results of importance, and I trust that the officers of the Carnegie Institution will not be disposed to look with disfavor upon the line of investigation in which I am especially interested because the facts demonstrated by scientific methods of research have a more or less direct bearing upon the welfare of the human race.

Geo. M. Sternberg.

In the discussion of the question of the scope of the Carnegie Institution, the chief thing, it seems to me, to be kept in mind, is that the revenues from this foundation should be directed to fields of research not provided for by universities, governments or other endowments. It is not so much 'what should be done' as 'what is not doing.' Lines of research which are not now

followed should receive first attention. In every branch of science is found a great unknown, an unexplored desert. Into these regions scientific research should penetrate.

The income of the Carnegie Institution is indeed large, but small when compared with the sum of private, public and governmental endowments of scientific activity in this country.

It may be assumed that the Carnegie fund will yield a half million dollars of available money annually. This is only a little more than one third of the income of Harvard University ($1,416,000), although the endowment of that institution is only about three million dollars greater than the Carnegie gift ($13,120,000).

The appropriation for the Bureau of Standards for the present year is $71,060; for the Coast and Geodetic Survey $828,525; for the Geological Survey $1,066,570; and the total appropriation for the Agriculture Department is $4,488,960 not including $720,000 for the agricultural experiment stations.

The total income of the agricultural colleges from the Land Grant endowment for the fiscal year ending June 30, 1901, was $708,010.45, and from the direct appropriation from the Federal Treasury ($25,000 for each one) $1,200,000. These colleges received from the several states $3,683,162.34 and from tuition and other fees $1,777,069.11, making a total income of the agricultural colleges of this country $7,386,241.60. The agricultural experiment stations received during the same time from the Congress of the United States $720,000, and from the several states and other sources $511,881.55, a total of $1,231,881.55. Of all this sum, amounting to $15,055,238.15, it is safe to assume that fully one third is devoted exclusively to scientific purposes—a sum ten times as great as the total income from the Carnegie fund. In this total no account is taken of the great endowments, public and private, to foster scientific research and activity in schools, colleges, universities and technical institutions.

It is seen from the above figures that the trustees of the Carnegie Institution will find a keen competition if they undertake any line of investigations already carried on under the auspices of the Government. In fact, I may be permitted to say here that the greatest danger, in my opinion, which now threatens the value of scientific work of the Government is a plethora of available funds. The best work of this kind is not necessarily done with access to unlimited supplies, and the *res angustæ* which compel a certain inventive ability to make both ends meet are sometimes highly useful in scientific research. The one mistake therefore which the trustees of the Carnegie fund will be certain to avoid is the granting of such bounties as will foster that hebetude which springs from satiety. If science should descend to the mere plane of a money maker it would then be time to form a trust to limit all activity and confer the revenues upon a chosen few. But that day is, happily, yet far off.

It appears to me that the life of the nation and its normal growth are the problems of supreme importance. Geography, soil, climate and race have conspired to make this nation the ruler of the world—far more powerful than le Tocqueville and Creasy ever imagined.*

Whatever our individual beliefs may be our nation is committed to hold the first place. We are powerless in the path of destiny. This means not only the political hegemony which is inevitable but also the physical force which that leadership implies. In this direction lies a field which the Carnegie trustees will find fer-

* See battle of Saratoga in Creasy's 'Decisive Battles of the World.'

tile. We need a fundamental inquiry into explosives as to both energy and stability. All means for the sudden destruction of life in battle should be of the highest efficiency. The engines of war should have the power and suddenness of a Mount Pelée. Especially our navy should be the strongest and most efficient of any in the world.

Of even pace with this development of destruction should be progress in the art of healing wounds and of preventing disease, since the greatest proficiency in war goes always hand in hand with the highest humanity.

Two of the great problems of a great nation are education and taxation. In these lines we want to get out of party and sect and lay deep and broad the foundations of true didactics and just taxation. The tariff should not be a political question and the farmer should not pay more than his share of the taxes, as he does at the present time. In education are included those problems in psychology which you so lucidly set forth in your paper.

Intimately associated with the problem of the nation's life is the question of alcoholic beverages. Where could be found a more promising field for investigation than in the discovery of the best way to avoid those awful miseries which the abuse of intoxicating beverages produces?

War, healing and avoiding disease, education, taxation, the unregulated use of alcoholic beverages, seem to me to be fields of research in which the Carnegie Institution might find almost an illimitable source of activity.

The art of war in its highest development is peace. Healing is health and long life. Education based on truly scientific principles is power. Taxation which is just and generous is resource. The use of alcoholic beverages properly conditioned is temperance. Peace, health, power, resource and temperance are the attributes of the ruler among the nations of the world.

H. W. Wiley.

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The side which appeals most strongly to me in connection with the development of the Carnegie Institution is the granting of research scholarships under the direction of existing laboratories. Mr. Carnegie's original intention in his Scottish University endowment was to render a liberal education possible to every Scot. It seems to me that the many scholarships made possible by Mr. Carnegie would permit of opportunity for research work by a great number of individuals desiring to do such work. The work would be valuable if its supervision were competent. To be a Carnegie research student might become a mark of honor and dignity. I would divide the scholarships into two classes: first, those receiving $1,000 a year devoted entirely to research, and second, those of $500 a year where half the day is devoted to research and the other half to college work.

The great and almost insuperable difficulty in this matter lies in the choice of laboratories to which these scholarships are to be allotted. It is practically impossible to avoid favoritism. The estimated value of work done lies in the current impression even though that may be full of error.

The scholarships should be allotted to laboratories the heads of which have shown themselves competent to do research work. It is a mistake to compel men, who are presumably competent, to reveal an outline of the subject to be investigated. The greatest discoveries are often accidental observations made by trained minds. The former product of their laboratories, or of their personal work, should be the crite-

rion. In this way if one line of investigation seems fruitless, the scholar can at will be turned in another course. Thus the Carnegie Institution may endow but not control the course of science in San Francisco. There must be no limitations to the 'akademische Freiheit.'

In my own laboratory I have always told my students, 'everything will be bought for you and all your breakage will be charged against the laboratory, if you will only give your time to the work.' It is the time of those capable of working which is the laboratory's most valuable asset. Would not scholarships, properly placed, liberate for higher uses the maximum of capable educated endeavor?

GRAHAM LUSK.

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IN response to the request for the views of American men of science on the mission of the Carnegie Institution, I would first of all express the hope that the trustees will reject those propositions which would most seriously menace the free development and untrammeled activity of our various scientific bodies and institutions of learning—especially the establishment of a huge reserve fund, with the annual distribution of its income among the 'deserving poor.' It seems to me that, while there may be occasional demands for large sums to equip exploring parties on behalf of some of the descriptive sciences, the legitimate demands for assistance in research in the exact sciences ought not to be very large, in any one year; in fact, I venture the assertion that the existence of large sums to be devoted in this way might lead to wastefulness in methods, rather than to the development of that resourcefulness which has been the characteristic of the greatest investigators. Favored beneficiaries might choose a field of work from which others would be debarred by questions of cost, rather than strike out upon lines of greater originality and importance. Again, it cannot be denied that the establishment of a standard of measurement with the utmost precision is a work well worthy of national support: but if the Carnegie Institution were to encourage, by means of its stipends, all our most capable physicists to devote themselves to this class of work, advance in this department of knowledge would be seriously hampered. Is it a hardy prediction, however, that the votes of a committee on distribution would always favor such definite projects, as against a proposition to explore some vaguely defined problem of physics or chemistry?

I think, therefore, that the proportion of the income to be devoted to the immediate subvention of research ought to be small at best; the aid would probably be more efficient, if administered through existing scientific societies, who would receive from time to time such additions to their research funds as would seem commensurate with their previous success in promoting investigation. The existence of a central reviewing body would act as a wholesome restraint upon these smaller scientific bodies, while the relative needs of investigators could be better judged by a jury of experts in their immediate field of work, than by such a heterogeneous committee as would be furnished by the trustees themselves.

On the other hand, the suggestion that the institution should play the part of a private benefactor to our universities, by adding to their endowment, building and equipping laboratories, augmenting professors' salaries or providing them with private assistants, seems to me to savor of paternalism and to open the way to serious abuses, while at the same time it might cause colleges to shape their course with the sole view of pleasing the guardians of the fund, for the time being.

It seems doubtful whether any salary could be paid to a body of academicians, sufficient to enable them to devote their whole time to research; and it is a fair question whether it would really be desirable to set a body of men apart in a scientific academy, at the present day, without that contact with students which a university provides. It must be remembered that the Royal Institution of London is not an academy in the strictest sense; nor do the resident lecturers owe a duty to a foundation, but rather to the subscribers. With the enormous distances separating our educational centers, it would not be conceivable that a lecturer could assemble around him so national an audience as would listen to a Faraday or a Rayleigh.

All these plans remind one of the hot-house method of stimulating plant-growth; why not attempt the open-air method of cultivating the soil? The Carnegie Institution might facilitate research for all, instead of offering incentives to a chosen few. For this reason, the satisfactory equipment of marine biological stations, open to all qualified observers, and of similar institutions that would render the natural phenomena more readily accessible to general study, would seem eminently proper; while one might doubt the propriety of establishing observatories simply for the intense study of single problems. The efficacy of special research laboratories in the physical sciences, such as England owes to the generosity of Mr. Mond, has yet to be proven in contrast with that of university laboratories; to the writer, their establishment in this country would appear premature, since many of our well-equipped educational laboratories are not so crowded that they would be obliged to refuse accommodation to an independent investigator who sought their hospitality.

The same general argument would oppose the financial support of periodicals and publishing organizations, while it would strongly favor the equipment of a scientific printing office, for the prompt and cheap reproduction of the results of research, for the account of individuals as well as of associations. However, if the trustees desired to obviate the most serious difficulties which beset the American scientist in his laboratory work, they would establish workshops for the construction of special apparatus and the preparation of the more recondite materials, such as rare chemicals, microscopic mounts, etc. What stipend, for instance, could put the American chemist on a level with his German colleague, when the latter can obtain, within twenty-four hours, any preparation that is catalogued, while the former must allow six weeks for obtaining anything that is not so commonly known as to be literally a 'drug on the market'? By enabling the private investigator to supply his needs quickly and at reasonable cost, without the unjust discrimination of 'duty-free' importation, a stimulus would be given to private research, inside and outside the college laboratory. Who can estimate the amount of time frittered away in this country through the lack of ready access to the mechanical adjuncts to investigation? Workshops to supply these would not only improve our immediate condition; but, if properly organized, they might serve to educate a body of mechanicians and preparators, whose help would be invaluable in the various scientific institutions of the country.

If these suggestions should illustrate the view that the Carnegie Institution can do measurable harm by seeking to supplant private initiative with artificial stimulus, but can do immeasurable good by clearing away the obstacles that now trammel the general growth of the scientific spirit in America, they will best express the opinions of

Morris Loeb.
New York University.

CLASSIFICATION AND ARRANGEMENT OF THE EXHIBITS OF AN ANTHROPOLOGICAL MUSEUM.*

Scope of the Anthropological Field.—The history of man, including all that he is and does and all that he has been and has done, is a wide and important subject, and is fortunately susceptible, in large part, of lucid and effective treatment in the museum. The available materials are of two principal classes; the first relates to man himself as a biological unit, and the second to the works of his hands, the creations of his developing mind. These two divisions of the subject are readily separated and require independent treatment in the museum. The first division is known as *Physical Anthropology,* often called Somatology; the second may in contradistinction be called *Culture Anthropology,* since it embodies the vast range of the essentially human activities.

The Somatic Division.—If we discuss man independently of his arts—his artificial activities—we treat of him from the standpoint of the naturalist or biologist. Physical anthropology includes the study of man as a species of animal, of his races and varieties, his external characters, his anatomy, physiology and pathology. It includes his ontogeny—the development of the individual—his inception and embryonic evolution, his advances to maturity, his descent to the grave and return to the elements whence he arose. It includes his phylogeny—the development of the species from lower forms of life; the evolution of every part of his frame—the skin, bones, muscles, circulatory system, nervous system and other special organs; and the relation of these parts one and all to corresponding parts of the lower animals. This is a magnificent field for illustration and, in capable hands, may readily fill a museum with exhibits of superlative interest and value. It is true that man is properly treated along with the lower orders of creatures as one of a great system of biological units, and he should therefore be included in all general biological presentations in museums. But anthropology requires more than this systematic biological treatment. Man's physical evolution and anatomical structure correlate directly with all his activities; race and culture are intimately connected. The naturalist could more consistently separate, in his museum presentation, the bird from her nest or the bee from its comb, than could the anthropologist divorce human handiwork from the man. There is excellent reason, therefore, for making an especial study and exhibition of physical man in immediate association with culture exhibits. It is necessary to bring together everything that relates to the great human unit. The anthropological museum should present physical man in the most complete and exhaustive manner. However, it is not the purpose at present to take up this branch in detail, but rather to give almost exclusive attention to the phenomena of culture.

The Culture Division.—If the physical phenomena of man include all that connects him *with* the brute, his culture phenomena include all that distinguishes him *from* the brute. If we wish to realize more fully the scope of the latter division of the subject, which includes the objective evidences of culture, we have only, in imagination, to sweep away all the multitude of things that it has brought into the world; destroy every city, town and dwelling; every article of furniture, picture, sculpture, book, textile fabric, fictile product; every article of clothing and ornament; every vehicle, machine, utensil and implement—and, in fact, every trace of human handiwork; set aside the use of fire and cooked food; ban-

* The scheme elaborated in this paper is now being carried out in the United States National Museum as rapidly as conditions will permit.

ish all language, social organization, government, religion, music, literature and intellectual life generally. When this has been done we may behold the real man standing in his original nakedness among his fellows of the brute world.

Limitations of Culture Material.—The material evidences of culture are thus seen to be of vast extent and importance; but it should be observed, notwithstanding this fact, that all of culture can not be illustrated in the museum, for we can utilize material things only. We cannot show by its collections the social, moral, religious and intellectual traits of man save in an indirect way. We can do little to illustrate language save by displaying the methods of its expression to the eye in pictures and letters. We can tell little of religion save by assembling the idols and devices that represent its symbolism, and the paraphernalia which pertains to the practice of its rites. We can tell nothing of music save by a display of the curious array of instruments used in producing sound, and society and government are even less within the sphere of the museum. Yet it is wonderful how much of the immaterial side of the race can be illustrated by the material things that man has used and made; for the mind is *in* the things and was developed *with* and *by* the things more than is commonly understood.

Classification of Culture Materials.—But what shall we attempt to show in the culture division of our anthropological museum, and how shall we classify and place our collections? Classification is the first essential. Taking a view of the world and its inhabitants from a sufficiently distant point of view, a few of the greater groups of facts attract the eye. *First,* we observe that men are of several distinct races and varieties; but a closer look demonstrates that these are not separated one from another, but are intermingled in such ways as to afford no basis save the most general for a grouping of their culture products. *Second,* we observe that nearly all peoples are separated into social and political groups—into clans, tribes and nations—occupying distinct areas of the habitable globe; looking closer at these, one sees that they are not all alike, that the widest possible differences in condition and culture status exist. Some of the groups are savages almost without art and without any evidences of higher culture; some are more advanced, occupying the barbarian grade; while still others are highly cultured and surrounded by a thousand evidences of enlightenment and luxury. Shall we then classify and display our museum exhibits on the basis of this grouping of the peoples into tribes and nations? Let us see what would be the result. The British Empire is a nation of commanding power and boundless territory, but its culture materials would comprise every variety of product under the sun, from the lowest to the highest, and from every known region of the globe. The same is true of nearly all of the civilized nations. It is evident, therefore, that units of this class are too large and too complex to be of use in classification. Besides, civilized nations may well be expected each to have and maintain its own national museum as an independent institution or as a department of its general museum.

Let us take another illustration. Suppose that we decide to arrange our collections by the inferior social or political units —as by states or tribes. Investigation shows that these units are too small, that we should have thousands of exhibition units —too many entirely for practical purposes of grouping and installation. Besides, some are artificial divisions and some are natural divisions, and the classification would be mixed and wholly unsatisfactory. What is

wanted is a simple natural grouping of the very diversified ethnic phenomena.

Glancing a *third* time over the field and noting especially the culture of the various groups of people, we find that it varies with the region rather than with the race or nation, and that there is a significant relation between it and environment. What uncivilized men do and have done in any region depends much on the climate and natural productions of that region. The arctic provinces have one culture, the tropical another; the arid plains have one group of activities, the humid region another. The inland district has a race of hunters and develops hunting arts, the maritime people becomes a race of fishers and develops fisher's arts, and so on. Culture is thus so much the outgrowth of the region that its products may be assembled by geographical areas, and these may be large or small as occasion demands. The continents, great islands and groups of islands are subdivided into minor areas. These are called by anthropologists specialization areas, because they have given special characters to the culture developed within them. They have nothing to do with political lines and they disregard modern civilization, because it has broken over all natural limits, and by means of railroads and ships carries its generalized culture to the ends of the earth. But as these areas are largely those in which specialized cultures have had their inception and early development, it is by them that the student can best study and the curator best illustrate the phenomena of humanity. Within the space assigned to each of these geographic groups in the museum should be assembled specimens of everything ethnical that the area produces, no matter what the race, the nation, the culture stage or the time represented, excepting always the intrusive generalized elements of civilization, which must be treated separately in museums of national history or in museums covering special limited fields, as art museums and industrial museums.

THE GEO-ETHNIC ARRANGEMENT.

Now the museum materials intended to illustrate a given geographic-ethnic territory should be such in character and so arranged that the student or visitor passing through the hall or halls in which they are installed may gather quickly a clear impression of the people and culture of the area represented. I say first *people* because, after all, it is the people we are studying, and a display of all the culture phenomena of a region without some definite illustration of the people concerned would be wholly unsatisfactory. The man himself as he appears in his every-day life is the best illustration of his own place in history, for his physical aspect, the expression of his face, the care of his person, his clothes, his occupations, his general appearance and social relations, tell the story with much clearness.

So, since we cannot display the people themselves, we should begin each of our ethnical exhibits by building a lay-figure group showing a typical family of the area illustrated—the men, the women and the children—engaged in ordinary occupations and surrounded by the things they make, and use and love. Physical characters should be portrayed with all possible accuracy and a correct impression of the disposition and social attitude of the members of the group should be given. Then around this family group should be arranged in separate cases series of objects illustrating their arts, industries and history.

Following the family group, the next most important culture unit is the dwelling group, which may be modeled in miniature (say one twelfth or one twenty-fourth actual size), and illustrate their houses and constructions of all kinds as well as some-

thing of the home arts and life. Miniature figures of men, women and children may be introduced into the dwelling group to graphically illustrate the practice of culinary arts, manufacture of basketry, weaving, pottery, the use of domestic animals, etc.

Illustrations of other activities should follow the dwelling group in the order of their importance or significance, each exhibit (consisting of the actual objects or of models) being of sufficient extent to serve as a synopsis of the work of the area represented. The method of arranging these series is discussed in detail further on. Along with these exhibits should be taken up the archeology of the area, the prehistoric cultural relics and remains, carrying the story back to the earliest times. The exhibit of each area should be supplemented by maps, pictures and labels, thus completing an attractive synopsis of its culture phenomena. If a particular area should happen to contain two or more distinct peoples or cultures, additional exhibits could be added according to space and needs, rounding out the presentation. If several tribes are included and require separate attention, the less typical may be represented by simple costumed figures instead of by family groups.

It would prove instructive to add to each of these ethnic exhibits illustrations of the physical characteristics of the peoples of the area. These may comprise casts of the face, or even of the entire figure; the skeleton, or parts of it, and especially the skull, which presents wide and significant variations; examples of artificial deformations and mutilations; and collections of such remains of fossil man as are found in the area. This exhibit may also include pictures, diagrams and maps, completing a synopsis of the somatic characters.

The geo-ethnic units, thus described, should be assembled in the museum somewhat as represented in Fig. 1. Here a portion of the ground plan of the exhibition hall is presented. An ordinary, somewhat limited ethnic unit occupies space *I.* of this diagram. The lay figure group stands at *A* and the associated exhibits extend across the hall, filling a single row of cases, and the wall cases of the alcoves. A larger unit is provided for in *II.*, where besides the single family group, *A*, additional lay figures are introduced (*a*, *b*, *c*, *d*) to represent the less conspicuous peoples. In section *III.*, two minor groups are placed, one on the right and the other on the left of the main aisle, with the family lay-figure groups in front (*BB*).

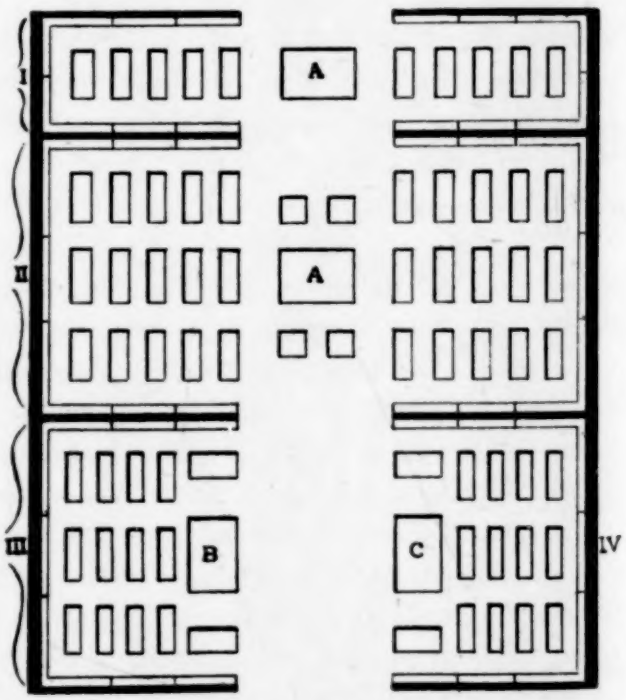


Fig. 1. Assemblage of geo-ethnic units of different sizes.

I. A small unit extending the full width of the hall and occupying a single line of cases. *II.* A large unit, also extending across the hall and occupying triple tiers of cases. *III.* A small unit confined to one side of the hall, with two rows of cases. *IV.* Similar to the preceding, with three tiers of cases. The wall cases in each instance are also utilized.

In many instances the lack of well-rounded collections will necessarily prevent the building of family groups, and, if cos-

tumes are at hand, single figures may take their place.

Since these proposed exhibition units are to represent terrestrial areas, it follows that their order in the museum should approximate as nearly as may be the geographical order. If, for example, we are dealing with North America, the most northern group or unit should come first, and the groups to the south follow according to degree of intimacy in geographical relations. In this way neighboring environments, cultures and peoples come together, and their interrelations may be presented and studied to advantage.

Assuming that the museum space to be occupied is an ordinary hall or series of halls having a convenient width of say 120 to 150 feet, the several members of each series would be assembled somewhat as shown in the diagram. The lay-figure cases, *A, A,* would be ranged down the center of the space with wide aisles at right and left, the associated exhibits, *a, b, c, d, e,* coming at the sides in whatever order seems most advantageous, each series extending entirely across the hall, as shown in *I.* and *II.* or otherwise, standing at the sides as indicated in *III.* and *IV.*, where *B* and *C* are the family groups facing the main aisle. The order and relative positions of the separate exhibits in each exhibition unit should be approximately uniform. The ordinary visitor would thus be able to pass down the central aisles, observing the various peoples as represented by the lay-figures, giving slight attention perhaps to the associated exhibits; while the student of a particular branch, as, for example, weapons of war and the chase, could pass from section to section, examining and comparing in geographical order the successive exhibits illustrative of this branch. The thing most to be desired in conducting the visitor through such a great series of exhibits is to bring the various features before him in logical order. The world is presented to him in miniature and the arrangement is such as to teach definite and important lessons.

It frequently happens that a particular ethnic area contains a cultural feature of exceptional importance, which is represented by such a large body of material that to display it in the systematic series would be to throw the whole representation out of symmetry. This exigency would be most happily provided for by arranging the plan and section of the museum building as indicated in Figs. 2 and 3. While the systematic geographical series are provided for in the main sky-lighted hall (*A*), and its lateral gallery spaces (*B*), say 140 feet in total width, lateral tiers of inferior side-lighted halls (*C*), properly connected by doorways with the main hall, may

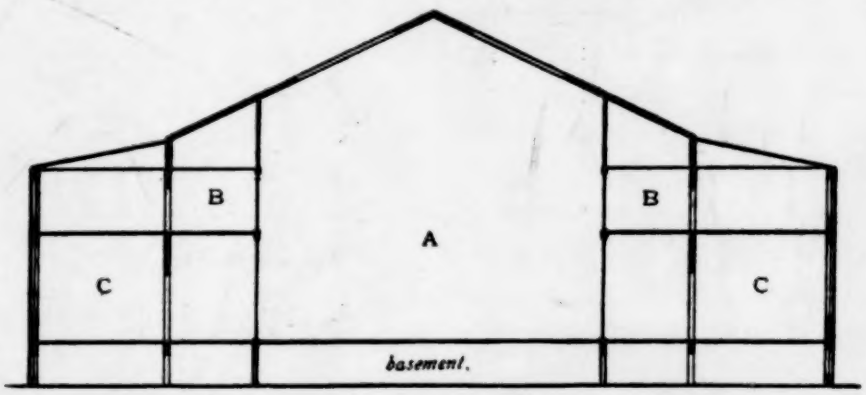


FIG. 2. Section of museum building, showing central sky-lighted hall, *A*, with galleries, *B*, and side-lighted halls, *C*. This grouping of halls seems well adapted to the great body of anthropologic exhibits.

accommodate the overflow of unusually developed features. This idea would apply most satisfactorily, for example, in the California area, where a great series of basketry products, so prominent a feature of the ethnology of that region, could be installed in one of the lateral halls (*C*), the systematic exhibit of the area occupying the full width of *A*. Or again, in the case of the Mississippi Valley area, the great body of archeological material could be placed in one or more of the side halls in suitable relationship with the central exhibits, which would consist of the systematic ethnic collections from that area.

The floor plan of the installation proposed above appears in Fig. 3. The arrangement of halls suggested is probably the best that can be made for general culture exhibits.

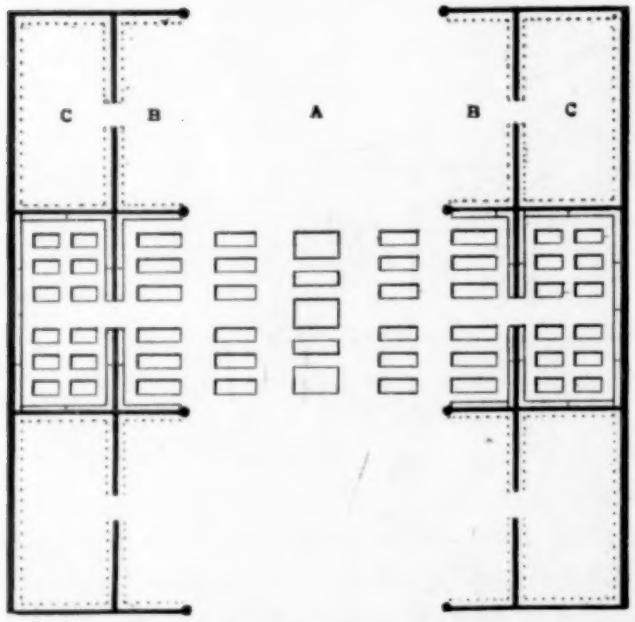


Fig. 3. Floor plan of extensive geo-ethnic unit showing overflow into lateral halls, *C, C*. One full-sized family group and two auxiliary lay-figure groups are provided for besides a large number of associated and auxiliary exhibits.

It may be asked whether some other arrangement of geo-ethnic or of other simple ethnic units may not afford superior facilities for examining the whole field of anthropological phenomena. If, for example, exhibits illustrating the various groups of people in the world should be assembled according to grade of culture rather than with respect to geographical order, the lowest group taking first place and the others following according to culture status, would not the survey of the field be easily and advantageously made? Would one not be able through this arrangement, employing the lay-figure groups and the attendant exhibits as before described, to study not only the peoples and compare their culture to good advantage, but to have in orderly view the full range of culture achievement from lowest to highest the world over? This especial concept is illustrated in Fig. 4, in which, instead of the lineal arrangement, a radiate grouping is suggested. The inner concentric space *A* could be occupied

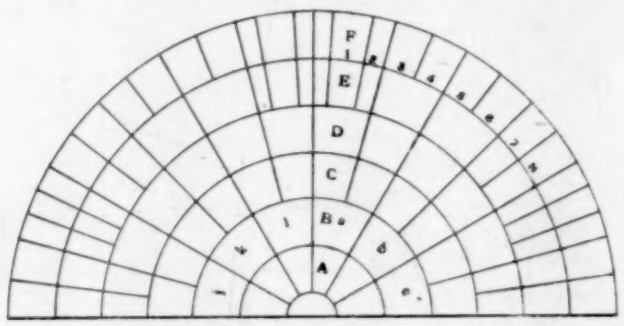


Fig. 4. Concentric arrangement of entire ethnic exhibit.

by the most primitive peoples, the succeeding concentric space *B* by the next higher peoples, and so on out to the periphery, while the various activities would occupy the radial spaces *A, B, C, D*. These latter would be few in number toward the center where peoples are simple and arts few (*a, b, c, d*), and numerous farther out where peoples are advanced and activities numerous (1, 2, 3, 4). To study a particular people, the visitor would follow the concentric lines (*a, b, c, d;* 1, 2, 3, 4), examining each of the activities of that people in turn. To study a particular grade of culture the world over he would follow the same plan. To study a particular branch

of culture in all its phases, he would pass from center to circumference, noting what each people had done in that branch (*A, B, C, D*). In doing this he would ascend the culture-ladder from the lowest to the highest round, traversing the full range of human accomplishment in the various activities. At the same time, if the exhibits were numerous and properly arranged, he could form a fair idea of what the race as a whole had accomplished, following the development of culture from beginning to end.

This seems at first glance a most complete and comprehensive scheme, for, fully worked out, it would present the peoples of the world, their activities and history, in a single view. But on closer inspection it is found to have numerous shortcomings, apparently unfitting it for general museum use. (1) In applying it, the important factor of the relations of peoples to one another in the world and to their environment must be disregarded; (2) the question of the order of the ethnic units would be difficult to settle, since many peoples are of one grade or nearly the same grade; while some occupy various grades in part; a tribe or nation may be advanced in one direction or activity calling for an outer place on that account, and backward in another, calling for an inner place; (3) such a grouping would be unsatisfactory save where collections are comprehensive and full; besides, (4) a building of unusual design and dimensions would be required; (5) a most serious objection is that this concentric arrangement of a comprehensive exhibit, consisting of thousands of units, would be highly perplexing to any but the trained museum student and wholly beyond the grasp of the ordinary visitor. Ninety out of every hundred persons would utterly fail to comprehend the arrangement. On the other hand, the straight-away succession of geo-ethnic units seriated according to geographic position (Fig. 1), though necessarily falling short in some minor respects, presents the great advantage of simplicity and directness. Units of all sizes are accommodated with equal facility—if a group be small a limited space can be assigned; if a group be large, a larger space or even an entire hall may be devoted to it. Comparative studies in the various culture-branches are carried on with reasonable ease, since a particular subject or class of exhibits has, as far as may be, the same relative place in each of the groups. Each culture feature may be studied to best advantage in actual contact with the other features of its own group, that is to say, the pottery of a particular group can better be studied in its own setting of related arts—basketry, sculpture, wood carving, etc.—than it can if separated from them.

The geo-ethnic assemblage of exhibits is generally applicable and affords many advantages, giving at once to ordinary visitors and to students a comprehensive notion of the peoples of the world and their culture in their true proportions and relations. It should be the fundamental arrangement in every general anthropological museum.

THE CULTURE-HISTORY ARRANGEMENT.

But this is not all that the museum can do to illustrate the history of man. Perhaps the greatest fact of humanity is its evolution. By the geo-ethnic arrangement just described we may amply present the peoples of the world, ancient and modern, and yet fail to convey any definite notion of the development of culture—of the progress of arts and industries, and the gradual unfolding of the human mind. These lessons of evolution may be conveyed by assembling artifacts representing the various activities, and seriating them according to the stage of culture which they

happen to represent. These series may be called culture-history, or culture-development series, and although they are not true genetic series, since the forms cannot be said to have arisen one out of another, they may in a general way stand for the genetic order, suggesting forcibly the manner in which one step necessarily gave rise to another from the lowest to the highest throughout all culture history.

These culture history series may be numerous and extremely varied in character. They may be mere synopses, giving only the great or epoch-making steps of progress, or they may embody many objects brought together from every part of the world. The curator may select only those branches susceptible of ready and effective illustration, the steps of progress being represented by the tools, utensils and devices employed in the practice of the art, or by the products where such exist.

A number of the more important series are included in the list which follows, where they are classified under a dozen or more heads. A majority of these series are now included in the exhibits of the National Museum.

In the *first* group are placed all those activities whose function is that of acquiring or producing the raw materials of subsistence or culture.

1. Plant gathering, agriculture, horticulture, forestry, etc. Illustrated by the implements and utensils used in (*a*) collecting, (*b*) cultivating the soil, (*c*) harvesting the crops.

2. Hunting and fishing and zooculture. Illustrated by (*a*) weapons, (*b*) traps and snares, (*c*) hooks and tackle, (*d*) appliances of domestication and culture.

3. Mineral collecting, quarrying and mining. Illustrated by mining implements and machinery.

In the *second* group are included the activities that prepare the raw materials for use, a few of which are as follows:

1. The building arts. Illustrated by (*a*) models of the house, (*b*) models of furniture, (*c*) models of water craft, (*d*) models of machinery, (*e*) devices used in construction.

2. The textile arts. Illustrated by (*a*) basketry-making appliances and products, (*b*) spinning appliances, and products, (*c*) the loom and loom products, (*d*) sewing and netting appliances, and products.

3. The sculptural arts. Illustrated by (*a*) implements for shaping stone, and products, (*b*) implements for carving wood, and products.

4. The plastic arts. Illustrated by (*a*) implements for modeling in clay, wax and other plastic substances, and products, (*b*) utensils and appliances for glass-making, and products.

5. The metallurgic arts. Illustrated by (*a*) metal-producing appliances, (*b*) metal-shaping tools and utensils, and products.

6. The graphic arts. Illustrated by (*a*) drawing and painting, (*b*) writing, (*c*) engraving, (*d*) printing, (*e*) photography. (Appliances and products in each case.)

7. Food-preparing arts. Illustrated by (*a*) contrivance for milling, (*b*) cooking appliances.

In the *third* group are the arts employing natural forces, as:

1. The use of light and heat. Illustrated by (*a*) devices for striking fire, (*b*) lighting appliances, (*c*) heating appliances.

2. Use of animal power. Illustrated by (*a*) devices for harnessing men, (*b*) devices for harnessing animals.

3. Use of water power. Illustrated by (*a*) water-wheel, (*b*) the hydraulic engine.

4. Use of wind power. Illustrated by (*a*) the sail, (*b*) the wind-mill, (*c*) the kite, (*d*) the flying-machine.

5. Use of steam power. Illustrated by the steam-engine.

6. Use of electric power. Illustrated by (*a*) the magnet, (*b*) telegraphic transmitters, receivers and insulators, (*c*) telephone apparatus, (*d*) the motor.

In the *fourth* group are implements of general use. Illustrated by (*a*) the hammer, (*b*) the knife, (*c*) the scraper, (*d*) the saw, (*e*) the ax, (*f*) the adz, (*g*) the drill, etc.

In the *fifth* group are the metric arts:

1. Counting. Illustrated by tallies and computing devices.

2. Time-keeping. Illustrated by (*a*) sun-dials, (*b*) hour-glasses, (*c*) watches and clocks, (*d*) chronographs.

3. Weighing. Illustrated by (*a*) balance scales, (*b*) spring scales.

4. Measuring (linear). Illustrated by (*a*) linear scales, (*b*) dividers.

5. Surveying. Illustrated by (*a*) compass, (*b*) theodolite.

In the *sixth* group are transportation arts:

1. Land transportation. Illustrated by (*a*) burden-bearing devices, (*b*) sliding vehicles, (*c*) rolling vehicles, (*d*) wheeled vehicles.

2. Water transportation. Illustrated by (*a*) the vessel, (*b*) the sail, (*c*) the propeller, (*d*) the rudder.

3. Air transportation. Illustrated by (*a*) the sail, (*b*) the balloon, (*c*) the flying-machine.

In the *seventh* group are the arts of war. Illustrated by (*a*) weapons, (*b*) armor, (*c*) fortifications.

In the *eighth* group are alimentary arts:

1. Eating and drinking. Illustrated by utensils and appliances.

2. Use of nicotine and narcotics. Illustrated by utensils and appliances for smoking, chewing, snuffing.

In the *ninth* group are costume arts. Illustrated by (*a*) dress, (*b*) jewelry, (*c*) tattooing.

In the *tenth* group are diversional arts, a few of which can be illustrated:

1. Games of skill, ball, etc.
2. Games of chance, playing cards, etc.
3. Toys, dolls, etc.

In addition, other groups may be mentioned as follows:

Eleventh, the art of music. Illustrated by musical instruments.

Twelfth, religious and other ceremonials. Illustrated by idols, symbols and paraphernalia.

Thirteenth, arts of commerce. Illustrated by coins and other forms of money.

Fourteenth, pathological arts. Illustrated by devices employed in medical practice and surgery.

These series may, when properly selected and arranged, afford striking and easily understood illustrations of the history of culture as recorded in material things. Some of the branches are of primordial origin, covering the whole range of progress, such as building, weaving and adornment arts, while others have arisen in recent times, such as printing, photography, the use of steam, electricity, etc.; but all alike furnish faithful records of the intellectual evolution of humanity.

The degree of elaboration in any branch of the exhibits must depend on the space available and on the materials at hand. A few specimens may form a most instructive synopsis, emphasizing the great steps of progress; while on the other hand, a single branch may embody extensive series of objects, as well illustrated in the collections of the Pitt-Rivers Museum, Oxford, where every available form of artifact is exhibited, covering not only the full range from lowest to highest, but indicating the forms peculiar to distinct peoples.

These series of exhibits, arranged to illustrate the development of culture in general, do not relate to any particular people or area, but represent all peoples and all areas. They cannot, therefore, be installed in direct association with the geo-ethnic series, but must occupy a separate space in the museum.

SPECIAL CULTURE SERIES.

Two great classes of culture exhibits have now been described. First, the *geo-ethnic* series illustrating groups of men and their works assembled by geographical areas, and second, the *culture-history* series illustrating the achievements of the race in various important branches of activity. Now it happens that there are numerous subjects worthy of museum illustration that cannot be presented in either of these series of exhibits without confusion, and these, therefore, call for independent or isolated installation. It is proposed to group them under the head of *special* ex-

hibits, and they may be as numerous and varied as we choose. Some of them may cover limited portions of the culture field, while others are general, comprehending a wide range. They may be classified and arranged in various ways, according to the nature of the concept to be developed; some may be chronologic, some comparative, others cyclopedic, and so on. A national exhibit, that is to say one intended to illustrate the history of a nation may be arranged chronologically, as in the historical exhibit of our National Museum. Here the successive periods, marked by important episodes, are as follows:

(1) Discovery, (2) Colonization, (3) Revolution, (4) War of 1812, (5) Mexican war, (6) Civil war, (7) War with Spain, etc. Within this series and forming part of it are special exhibits, as those representing public personages. In the section illustrating the revolutionary period, for example, there is a minor exhibit relating to Washington, and consisting of various articles, personal and otherwise, arranged for effect or according to relative importance of the relics. This national exhibit is not a true geo-ethnic unit since it covers only three of four centuries of the ethnic history of the area included, and although arranged chronologically, it is not illustrative of culture in the broadest sense.

A collection of paintings is susceptible of varied special treatment. It may be arranged (1) chronologically, (2) by countries, (3) by schools or (4) by painters. An exhibit of book-bindings might represent the work of (1) an individual, (2) a firm, (3) a school, (4) a period, and so on.

Special comparative exhibits may be of much interest and value. They may be synoptical or cyclopedic. An exhibit of bows and arrows, for example, may be synoptic, containing only typical examples from the various regions and peoples, or cyclopedic, containing all available specimens from all sources.

The culture exhibits for a museum of anthropology may thus best be assembled in at least three distinct divisions, each illustrating a different kind of unit of culture and serving to convey distinct classes of information, or the same kind of information in different ways. So the museum space allotted to culture is separated into three parts, accommodating the geo-ethnic groups, the culture-history series, and the special exhibits.

GEO-ETHNIC GROUPING ILLUSTRATED.

The significance of the geo-ethnic exhibits already described will be readily understood by referring to Fig. 5, a map of North America, on which are outlined in the most general way some of the principal geo-ethnic or geographical culture districts—the characterization-areas of the continent. These areas are not always well defined and there is a good deal of overlapping and ethnic intermingling. In some cases it is difficult to say of a particular area which tribe should be taken as a type, and the materials at hand must decide this, since only those tribes can be systematically shown from which collections are ample. In the main, however, the delimitations are sufficiently definite for all practical purposes. The areas suggesting themselves are as follows:

1. Eastern Arctic area (Eastern Eskimo).
2. Western Arctic area (Western Eskimo).
3. McKenzie-Yukon area (Tinneh).
4. Northwest coast area (Tlinkit, Salish).
5. Columbia River area (Nez Percé, Chinook).
6. California area (Klamath, Tulare).
7. Great Basin area (Bannock, Ute).
8. Colorado-Rio Grande arid area (Pueblo, Apache).

9. Great Plains area (Blackfoot, Kiowa).

10. Great Lakes and North Atlantic area (Chippewa, Iroquois).

11. South Atlantic and Gulf area (Seminole, Choctaw).

12. Arkansas-Texas area (Wichita, Caddo).

16. South Mexican area (Zapotec, Miztec).

17. Yucatan-Guatemalan area (Maya, Maya-Quicha).

18. Costa Rican Isthmian area (Mosquito, Chibché).

19. West Indian area (Carib, Arawak).

FIG. 5. Map of North America, indicating in a general way the ethnic provinces.

13. Northeast Mexico and Rio Grande area.

14. Sonoran area (Mojave, Huichol).

15. Central Mexican area (Aztec, Otomi).

In all these cases we deal exclusively with the native ethnology, as the superposed European culture is too widely distributed to be treated by limited districts, and transportation from region to region is now so

easy that a particular or peculiar environment is no longer capable of impressing its stamp upon its people and art. Modern culture has to be treated by artificial, not natural, areas, and is becoming so generalized that distinctions of art are disappearing, and we must illustrate it, if we illustrate it at all, in one cosmopolitan group. But let us see what these culture areas mean.

It must have been an untoward chain of circumstances that drove the Eskimo peoples into the frozen zone (areas 1 and 2, Fig. 5) occupied by them, for at first glance it would seem that human creatures could not survive even for a year in such an environment; but they found means of living, and withal are a healthy and energetic people. But their culture is necessarily very circumscribed and exceptional, developed as it was in, or modified by, the peculiar surroundings. These people necessarily have clothing, but as the garments are of skins and furs, the textile art is almost unknown. They must also have fire, but their fuel is fat. They venture out in boats to capture the seal, but as they have little wood their boats are made of skins, and are distinct from the boats of other groups. They travel by land also; but their vehicles are on runners and made of driftwood and bone. They hunt game, but as this consists largely of marine animals, they have invented peculiar weapons and appliances. They build houses, but these are unlike those of any other climate in the world, being often made of whale bones or of frozen snow. They carve curious figures in ivory, bone and wood, but these have no parallel among other peoples. They have no pottery, because the climate is not favorable to its development, but also largely because they do not commonly cook their food. Notwithstanding their most dreary and inhospitable surroundings, they are a clever people and invent and use the most cunning traps, snares and weapons in the world. They are a cheerful people, and enjoy existence in their way as keenly perhaps as the more favorably situated peoples.

Can the culture phenomena of any other region or climate be as peculiar and remarkable as this? Strange to say, this is not a rare instance of individuality in culture development and characteristics. Take the area marked 4 on the map and note what strange contrasts occur. Area 1 has no wood, but in area 4 wood abounds; there the great cedar and the shapely spruce grow, and the ingenious tribes of Indians have used them extensively. So important a feature of this environment are they that the culture phenomena—the arts—are largely regulated by them. The people go to sea in boats, but they are not boats of skin; they are made of the noble cedar trunk, and the stable craft are well shaped and beautifully carved and painted. The people live in houses, but these are not of snow or whale bones, but of wood of the hemlock. Their houses are also works of art, with carved and painted ornaments, and supplemented by wonderful totem poles sculptured in the most fanciful forms. The hemlock and the spruce have made these peoples a race of builders and sculptors. They do not wear skins exclusively, but have woven garments, because the cedar bark and the wool of the mountain goat make the textile art easy. They do not make pottery, but they carve the yellow spruce into wonderful vessels, spoons and chests, and they have transferred their skill in carving to stone, and now are veritable sculptors, made so because the forest trees of this particular environment dictated the lines in which many features of their culture should grow.

It is unnecessary to go further into details, as the reasons are clear for assem-

bling our ethnical collections by geographical areas, and it only remains to indicate in some detail how these collections are to be grouped and displayed in the museum.

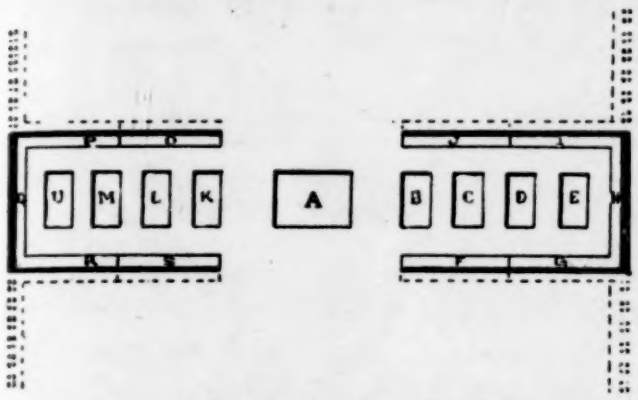


FIG. 6. Geo-ethnic unit. *A*, Lay-figure group, case 8 by 12 feet; *B*, House models; *C*, Boat models; *D*, Sledge models, harness, snow-shoes, etc.

In the accompanying diagram (Fig. 6) we have a scheme for arranging one of the geo-ethnic units. The area selected is that of the Eastern Eskimo (area 1 on the map). In the center of the exhibition hall we place the group of life-size figures, *A* (Fig. 6), showing how the people look and, as far as possible, what they think and do and have. This is the key to the exhibit—the most essential feature, and one from which the most casual observer can get a definite conception of the people and their culture. The particular episode depicted in the group, shown in Fig. 7, was selected for the purpose of illustrating, amongst other things, the cheerful disposition of those farthest-north people. Then ranged around this group should be cases containing everything that will serve to indicate more fully and accurately the nature of their activities and culture. Case *B* should contain models of the various forms of dwellings—the snow-house, the earth-covered hut and the improvised shelter, with all varieties of attendant structures; Case *C*, models of their boats, while actual examples may be placed near at hand if space permits; Case *D*, their sledges, snow-shoes, etc., the sledges represented mainly

FIG. 7. Lay-figure family group of Greenland Eskimo.

by small scale models; Case *E*, their hunting weapons, traps and snares; Case *F*, their fishing implements and apparatus; Case *G*, their knives and other tools of general use; Case *H*, their lamps; Case *I*, their carvings and graphic art; Case *J*, their clothing and personal ornaments in detail; Case *K*, their toys, dolls and masks; and so on. A reasonable space should be devoted to crania, casts from life, and pictures showing physical characters. Such archeological material as pertains to the region should also be shown. Where there are striking distinctions between the northern, the central and the Labrador group of these Eskimo, duplicate exhibits should be installed and separate lay figures of men, women and children prepared to illustrate important variations in physique and costume. The manner of arranging the specimens of the several exhibits in their cases is necessarily much varied, and it does not seem advis-

(*a*)

Aborigines of North America
The Eskimo

(*b*)

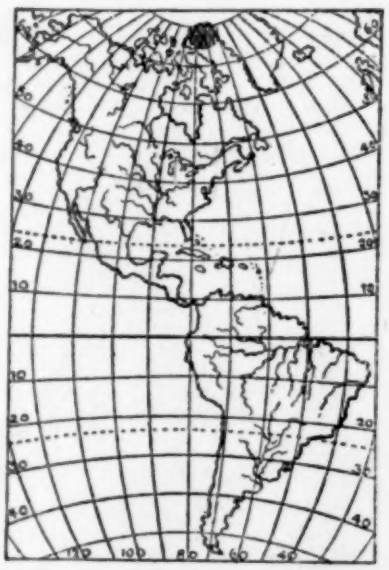
The Eastern Eskimo
Family Group of Smith Sound

(*c*)

FAMILY GROUP OF THE SMITH SOUND ESKIMO.

TYPE OF THE EASTERN ARCTIC REGION.

This exhibit shows an Eskimo family of Smith Sound, in northwestern Greenland. The Smith Sound Eskimo are called the Arctic Highlanders and are the most northern people in the known world. On account of the prevalence of ice they do not have the kaiak, or skin canoe, but use the dog sled for transportation. Their clothing is from skins of seal, reindeer, birds and dogs, and their houses are of snow. Nearly all of their activities are associated with the struggle for existence, and little attention is given to art work.



This group represents the family as it might appear in the spring, moving across the ice fields. The young man has succeeded in clubbing a small seal, and the others are having a laugh at his expense for calling on the dog team to haul it home when he could have carried it on his back. It is remarkable that these farthest north people are exceptionally cheerful in disposition, notwithstanding the rigor of the climate and the hardships of their life. The woman who carries a babe in her hood is about to help attach the seal to the sledge; and the girl who plays with the dogs, and the boy who clings to the back of the sledge, enjoy the confusion of the young hunter.

Designed by W. H. Holmes; modeled by H. J. Ellicott.

able to enter further into the details in this place.

The labels required in this ethnic unit are as follows: (*a*) *A sign*, about 12 by 24 inches to be suspended above the exhibit, serving to correlate it with the associated descriptive label, which go with each exhibit, referring to it as a whole, all save the family group require labels for the individual specimens. One example of these *specimen labels* (*d*), taken from the dwelling group series may be given:

(*d*)

DWELLING GROUP OF THE CENTRAL ESKIMO.

TYPE OF THE ARCTIC REGION.

The Central Eskimo live on the area between Hudson Strait and Baffin Bay. Their winter houses are built of blocks of snow laid up in a spiral manner, forming a dome. The blocks are about three feet long, two feet high and six inches thick. The main chamber of the house varies from five to twelve feet in height, and from seven to fifteen feet in diameter. Over the entrance a square is cut out and covered with seal intestine for a window. The dome is connected by passageways with one or more outbuildings or packing rooms. In the summer the natives fish in the open water; in winter seals are taken by nets set under the ice. Dogs are attached to the sled by separate lines. The clothing of the men and women is made from skins of seal and deer, and consists of outside and inside trousers, jackets (those of the women having hoods), boots, and inside boots or socks made of light deer skin or bird skin.

This group forms one of a series designed to set forth the dwellings and home life of native tribes in the Western Hemisphere.

units in the Museum series. (*b*) *Case label*, about 5 by 16 inches, to be framed and placed on or immediately above each case to designate its contents in a general way and expressive of the broadest classification. The case label for the family group is as shown above.

(*c*) *Descriptive label*, about 8 by 10 inches, two copies to be framed and hung in each exhibition case near the level of the eye. That for the family group is shown.

Beside the case label and the general

CULTURE-HISTORY SERIES ILLUSTRATED.

The nature of the *geo-ethnic* or *specialization area* assemblage of the culture materials of the world has been sufficiently shown in the preceding pages. It is the first and most important method for a general museum. It remains now to explain briefly the nature of the *culture history* installation, a partial list of the available exhibition units of this class having already been given.

In Fig. 8, we have a scheme for placing

and labeling a series of exhibits illustrating progressive steps in the art of sculpture. The other series are to be treated in like manner. This art began very early in the career of the race and in forms so simple that they would not at first be recognized as belonging to the art of sculpture by the

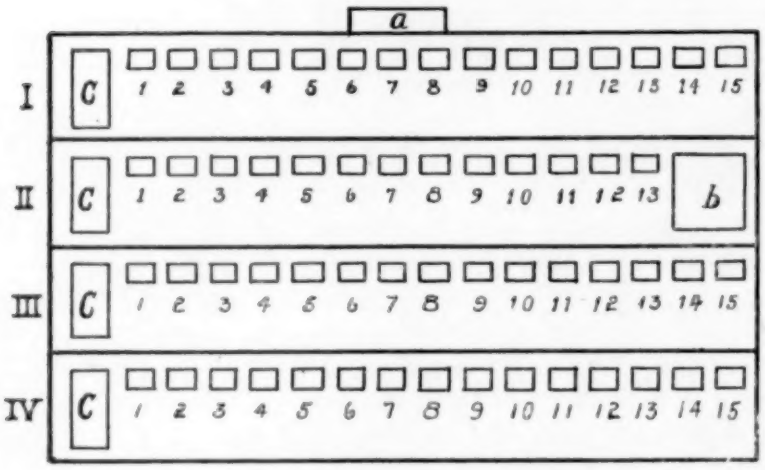


FIG. 8. Arrangement of a synoptic exhibit illustrating the history of sculpture as elaborated in the U. S. National Museum. *I.*, Series of tools and appliances. *II.*, Series of aboriginal American sculptures. *III.*, Series of oriental sculptures. *IV.*, Series of Mediterranean sculptures. *a*, Case label. *b*, General descriptive label. *cccc*, Series labels. 1, 2, 3, 4, etc., Specimen labels.

unscientific student. We are able to trace it more fully than any other art because its products are in stone which is not seriously affected by lapse of time. Then again, the tribes and nations of to-day are found to be practicing every known step in the art, from the most elementary to the most highly perfected, so that its whole history comes well within the range of present observation, and examples of the tools and the work are available. The first conscious step in the art was probably that of fracturing one flinty stone with another, with the view of securing a sharp edge for cutting and scraping. Three other processes that must have come early into use are those of shaping by pecking, by grinding and by cutting, and for a long period of human progress the only sculpture consisted of shaping useful implements by these methods. Even to-day these are the processes mainly used, the tools and appliances being simple with primitive people and more highly developed among cultured nations. Mechanical aids of considerable complexity are sometimes employed by our modern sculptors.

The first group of exhibits illustrating the history of the art may well consist of a progressive series of the shaping implements and devices, while two or more additional series may show the sculptured products.

In the first stages of the art only simple useful articles were made; later these were elaborated esthetically and personal ornaments were added; then gradually the processes were applied to working out the rude block-like, imperfectly proportioned figures of animals and men; these were totems, fetiches and idols, and illustrate a third stage in our progressive series. Later still, portraiture was attempted and a kind of rigid formal likeness was worked out, marking a fourth step. Then with the higher nations, correct form and expression came into being, and finally the realistic and ideal work represented by the highest Greek art was developed. Exhibits illustrating the more advanced phases should embody originals of the smaller objects and small-scale reproductions of the larger. If collections are ample, it will prove interesting to treat the development of the art on each continent or in each great cultural province separately, as indicated in Fig. 8, thus affording facilities for interesting comparative studies. America may furnish one series of exhibits in which the course of development through the several primitive grades up to the stage of well relieved figures and rude portraiture is traced (16 numbers). The Orient may afford a series somewhat more complete (18 numbers), and the Mediterranean province yields il-

(*a*)

History of the Arts and Industries.
Synopsis of the Art of Sculpture.

(*b*)

SERIES 2. ABORIGINAL AMERICAN SCULPTURE.

The American tribes displayed a strong predilection for sculpture. They shaped their stone implements with great skill, and delighted in representing animal forms. Religious motives inspired most of the more elaborate work, although esthetic appreciation was not wanting.

The series of objects here presented covers nearly the full range of native achievement, although the best examples shown fall short of the highest types of Aztec and Maya work. The simpler forms are placed at the left, and a series of progressive steps lead up to the higher forms at the right. It is believed by some that germs of culture have occasionally reached America from other lands and that sculpture on this continent is not wholly of native growth.

The practice of the art in its higher forms has, for the most part, been abandoned by the native tribes, but stone implements and utensils are still made in some remote districts.

(*c*)

HISTORY OF SCULPTURE.

The term sculpture is here applied to the whole range of processes and products pertaining to the shaping of stone, but does not extend to the carving of wood, bone, ivory, or other like substances, the modeling of plastic materials or the shaping of metals. The products of the art, briefly epitomized in this exhibit, constitute a most important record of human progress, for they tell not only a story of technical and industrial development but throw many side lights on the history of religion, esthetics and general culture. It is observed that with very primitive peoples the shaped forms are implements and utensils merely, but that with advancing culture ornaments are made and life forms gradually appear, and that in civilization realistic and ideal phases of the art are dominant.

In this exhibit we have to deal with two classes of artifacts; first, the implements and appliances used in manufacture, and second, the shaped product. The shaping processes include flaking, pecking, cutting and grinding in their various forms, and the implements and devices used are in the main extremely simple even in the advanced stages of the art. The implements are arranged in progressive order in Series 1, and the sculptured product in some of its varied phases appears in Series 2, 3 and 4. Series 2 indicates the range of native American work; Series 3, the sculpture of the Orient; and Series 4, the full scope of the art as developed on the shores of the Mediterranean.

(*d*)

No. 13.—Human and animal figures combined in a miniature totem pole, sculptured in partial relief, material black slate, shaped with metal tools. Northwest Coast Indians. Period recent. 178,064

(*d*)

No. 14.—Human figure, fully relieved, but falling short of the best Central American work. Material gray, porous lava. Probably shaped with stone tools. Precolumbian period. 61,814

lustrations covering the same ground and besides furnished additional steps up to the highest achievements of human genius in this art (20 numbers).

Four kinds of labels are required for the sculpture exhibits as follows:

(*a*) *Case label,* about 4 by 16 inches; framed and placed at the top of the case *A* (Fig. 8).

(*b*) *Group label* descriptive of the entire exhibit; size about 8 by 10 inches; framed and hung at a suitable height within the case (*B*, Fig. 8).

(*c*) *Series label,* to be placed at the beginning of each series. The example given pertains to Series 2 of the sculpture exhibit (*C*, Fig. 8).

(*d*) *Specimen label,* briefly describing the specimen, and placed with it in each instance. The examples given belong to specimens 13 and 14 of the American Series (*D*, Fig. 8) as installed in the National Museum.

The sculpture exhibit as installed in the National Museum occupies a space 5 feet high, 8 feet 6 inches long and 12 inches deep. It includes about 100 specimens and 60 labels.

The ends to be subserved by the exhibits of a general anthropological museum are mainly those of education, and the aim of the classification and arrangement here proposed is to so present the collections that the student as well as the ordinary museum visitor may secure the maximum benefit from them. As indicated at length in the preceding pages, the three great ideas capable of satisfactory presentation are: (1) the biology of the race—the origin, evolution and present characteristics of physical man; (2) the ethnology of the race—the various groups of people and their culture; (3) the history of culture—the evolution of arts and industries. To these three series a fourth is added, which consists of various special exhibits, each teaching its individual lesson. The anthropological collections are thus assembled in four grand divisions separately installed.

W. H. Holmes.

U. S. National Museum.

*A BIOLOGICAL FARM FOR THE EXPERIMENTAL INVESTIGATION OF HEREDITY, VARIATION AND EVOLUTION, AND FOR THE STUDY OF LIFE-HISTORIES, HABITS, INSTINCTS AND INTELLIGENCE.**

The biological laboratories of to-day, in design, equipment and staff, are almost exclusively limited to the study of *dead* material. Living organisms may find a place in small aquaria or vivaria, but they are reserved, as a rule, not for study, but for fresh supplies of dead material. It is no disparagement of the laboratory to point out a broad limitation in its ordinary functions and the pressing need of new facilities for observation and experiment on *living* organisms.

The fundamental problems of heredity, variation, adaptation and evolution cannot be wholly settled in the laboratory. They concern vital processes known only in living organisms—processes which are slow and

* Read to the Corporation of the Marine Biological Laboratory, at the annual meeting, August 12, 1902.

cumulative in effects, expressing themselves in development, growth, life-histories, species, habits, instincts, intelligence. These problems require, therefore, to be taken to the field, the pond, the sea, the island, where the forms selected for study can be kept under natural conditions, and where the work can be continued from year to year without interruption. Such a field, combining land and water, and stocked with animals and plants, and provided with a staff of naturalists, would have the essentials of a biological farm, now justly considered to be one of the greatest desiderata of biology.

This great need (pointed out in all our annual programs since 1892, and named as one of the three leading purposes of the Culver endowment) has been felt ever since Darwin's time, and has been strongly urged by such evolutionists as Romanes, Varigny, Galton, Weismann and Meldola. Thus far the project has not been realized, except on a small scale through individual effort.

The most notable move in this direction is that of Professor Cossar Ewart, of the University of Edinburgh. 'The Penycuik Experiments'—the first product of Professor Ewart's enterprise—form a brilliant illustration of the kind of fruit to be expected from a farm devoted to experimental research. Single-handed, Professor Ewart attacks the problems of heredity, and quickly shows how decisive are direct experiments in dealing with such subjects as telegony, prepotency, reversion, inbreeding, etc.

The plans proposed by Romanes and Varigny had as chief ends in view demonstrative tests of the theory of the origin of species by natural selection. But the contest between the old belief in the immutability of species and the new doctrine of descent has been decided, and the original idea of the farm has consequently ceased to have great influence.

The functions to be fulfilled by a farm are no longer prescribed by the exigencies of theories, but by the deeper and broader needs of pure research on *living* organisms. The problems of heredity and variability are fundamental, and naturally form the center of interest. Variability is the source of new species and the fountain of all progressive development in the organic world. In heredity lies the power of propagation and continuity of species. These are inexhaustible subjects, from the investigation of which must flow rich accessions to knowledge, which will redound to the advancement of human welfare.

These subjects are in some aspects and details amenable to laboratory research; but for the most part they can only be effectively dealt with under conditions represented in the farm. This holds, for example, in that most promising branch of experimental biology—*hybridisation*. Botanical gardens and zoological parks have been utilized to some extent in this work, but they are adapted to show-purposes, and are of little value for research of this kind. The far-reaching importance of this subject, for both science and practical breeding purposes, is well attested in Mr. Ewart's experiments, in those of Hugo de Vries, as recorded in his monographs on the origin of species in the plant world, and again in Mr. Bateson's 'Experimental Studies in the Physiology of Heredity.'

The functions of a biological farm are not all summed up in experimentation. That old and true method of natural history—*observation*—must ever have a large share in the study of living things. Observation, experiment and reflection are three in one. Together they are omnipotent; disjoined they become impotent fetiches. The biology of to-day, as we are beginning to realize, has not too much laboratory, but too little of living nature. The farm will certainly do much to mend this great

deficiency. The farm would enable us to work out life-histories, bring us face to face with instinct, put it under control so that we could handle it, photograph it, analyze it, read its history, and extort from it an answer to the question, Whence and how came intelligence?

It would enable us to extend the study of development beyond the stages represented in the egg and the embryo to those leading up to mature age, and thus bring within reach vast series of most important data for the study of evolution.

In such data we might expect to see to what extent individual development recapitulates race development, and to get important clues to the meaning of this so-called biogenetic law. The whole meaning of development and heredity is involved in these phenomena of 'recapitulation.' That the first step in recapitulation is the germ-cell, we know. The fertilized germ, or egg, passes through a series of form-stages, leading through the morula, blastula, gastrula, embryo, larva, etc. Whether these stages epitomize the ancestral series is a question very difficult to decide, and opinion is much divided. This obscure but fundamental problem of development can probably never be solved by embryological data alone. Paleontology throws much light on the general question, but deals entirely with non-living remains. If there be recapitulation, it should certainly be discoverable in post-embryonic stages, where characteristic features are slowly elaborated and brought to a completion in detail quite beyond the possibilities in earlier life. Strange to say, these later stages have been but little studied in living forms, museum morgues having been the chief reliance. It is in these stages that recapitulation may be actually seen as a life-process, successive steps in evolution repeating themselves with sufficient fullness to satisfy the most skeptical. Such sequences are often manifest in the development of instinctive behavior, and even in voice-changes and food-instincts at certain life-epochs corresponding seemingly to evolution epochs. Remembering that the distant ancestors of land animals were undoubtedly aquatic, the history of individual development in amphibious forms of to-day becomes intelligible as an abbreviated and variously modified record of race development. Making all allowance for secondary adaptive changes, it is nevertheless safe to say that race evolution is sketched in the development of the individual—sketched not only in fundamental features of structure, but also in the accompanying physiological and psychological changes.

Reminiscences of aquatic life are seen not only in land animals that return to the water to deposit their eggs, but also in all the higher animals, since they begin life in the unicellular stage and require for their first development to be bathed in fluid.

Sequence in color-patterns, so characteristic of young animals of almost all species, and especially so of birds, furnishes innumerable illustrations of the biogenetic law, and in many cases, where only two extremes of the sequence are present, it is possible by simple experiment to bridge the gap, and thus to show that the two extremes are really two stages of a continuous development. For example, in some wild species of pigeons we find that the color-pattern of the first plumage succeeding the down is so different from that of the second (adult) plumage, as to appear to have no direct developmental relation to it. By plucking one or more feathers from the first plumage at different times before the first molt, intermediate stages can be obtained, showing precisely how the first pattern can be progressively converted into the second. Such experiments enable us

to force from nature more complete records of her past and present doings.

Work on living organisms, dealing with such subjects as heredity, variation, adaptation, correlation, development, recapitulation, hybridisation, origin of species, nature of specific characters, life-histories, habits, instincts, intelligence, etc., requiring uninterrupted continuance from year to year for long periods, under conditions that secure most favorable control for experimentation and study, calls for facilities which have yet to be provided.

There is no quite satisfactory name for the new plant required for such work, and no one has suggested a practical method of developing it. Biological Farm, broadly defined, is perhaps the best we can do for a name, as the work would be, so far as possible, upon plants and animals under cultivation. A considerable tract of land, of varied surface, including woods, fresh-water ponds, some brackish water, and a stretch of sea-shore that could be utilized in the cultivation and study of marine animals, would represent the essentials of the farm headquarters.

The best location for the farm would be in the immediate vicinity of a laboratory holding the position of a national center of biological research. The Marine Biological Laboratory has a good prospect of becoming such a center, if it is not one already, and its proximity to the United States Fish Commission Station only insures additional advantages, of great importance to the farm. The farm, the laboratory, and the station would be reciprocally helpful and stimulating, and in many problems the three could work hand in hand, each supplementing the work of the others. These three establishments would form a most comprehensive biological center, such as has never been equaled.

In dealing with the problems of heredity and variation, it is of the highest importance to know the *history of the material* to be investigated. It is this prime essential that is so conspicuously missing in most of the work hitherto done in these lines. Curves and formulæ may be all right mathematically and yet all wrong biologically. Even Galton, the father of the statistical school, warns us that 'no pursuit runs between so many pitfalls and unseen traps as that of statistics.' ('Biometrika,' I., p. 8.)

The farm will furnish material with *exact records,* and will thus render a most important service to laboratory workers. A single illustration will suffice. It has been discovered that the paternal and maternal chromosomes in the cross-fertilized egg remain distinct, at least in the earlier stages of development. This seems to account for the fact that hybrids of the first generation between distinct species are generally 'intermediates.' When these hybrids breed *inter se* or with the parent species, we often get so-called 'reversions.' Hitherto we have not found any explanation for these 'reversions.' The solution of this most interesting problem in heredity only waits for the right material with precisely defined origin, and for this the laboratory could look to the farm. But the farm would do more than supply the needed material; its records and experiments would suggest the theory and give the physiological test, while the laboratory work would find the morphological test. The cooperation between laboratory and farm would thus be intimate and of inestimable value in a multitude of ways.

It must be remembered, moreover, that Wood's Holl has great natural advantages as a location for the farm. Ever since Baird's time it has been generally known that this is the best place on the Atlantic coast for the study of marine biology. Indeed, Wood's Holl has become a strong biological center by virtue of the excep-

tional opportunities for work here offered in a varied and extensive shore fauna and flora, in numerous accessible islands rich in forms of peculiar interest, and in many perfectly isolated fresh-water ponds, brackish ponds, and salt-water ponds of easy control. These attractive features, together with a climate suited to both winter and summer work, certainly comprise the essentials of a good location.

A further consideration in favor of this location is the fact that here for the first time in this country the farm project was definitely formulated; and, what is more to the point, it is here that the first step in the development of a farm has been taken, and the work carried forward for some six years by individual endeavor. The birthplace of an enterprise is not likely to be a pure accident. In the present case it was certainly determined by the various causes which have conspired to make Wood's Holl a biological center. This center has at least fifteen years of growth, and every year makes it stronger and increases its importance as a location for the headquarters of a biological farm.

The argument for location has already suggested that the farm is not necessarily limited to a single tract of land. It is designed to supplement, and cooperate with, a laboratory, and hence must have its headquarters conveniently near. There is no reason, however, for limiting its territory to the ground selected for this purpose. If, to take a familiar example, a study of the terns were to be undertaken, we should undoubtedly resort to Penikese, taking advantage of the headquarters selected by the birds. If we were to take up some groups of migratory birds, we might find it desirable to migrate with them, changing our location to suit their summer and winter predilections. For forms settled in tropical regions, longer excursions might be necessary, and this might lead to the development of a new farm. These possibilities do not in the least conflict with the plan proposed for Wood's Holl. No matter where a farm be located, it must have headquarters, and occasionally extend its field of work to more or less distant points of interest.

The headquarters must be in close touch with a laboratory, and both should be in a place where the natural advantages and the organization are such as to draw a large number of investigators—most emphatically not in a place that invites a large number of spectators, as in the public parks of cities. In this latter respect Wood's Holl is most perfectly adapted to the purpose, and the prospect is good that we shall never be troubled with throngs of summer visitors. This is an ideal feature in the situation that it would be hard to duplicate.

The practical question arises as to how to proceed with the development of a farm. Our limited experience strongly confirms the opinion with which we set out, namely, that the best method is to develop the farm slowly, section by section. Each section should be a group of related species, selected with a view to combining a wide range of problems. It should be developed and directed by an investigator prepared to make it his life-work. This investigator or director should have the support of a number of assistants competent to deal with special problems, one or two artists, a photographer, a keeper and a business superintendent.

Developed in this way, the cost of maintenance would not be heavy at first. Ten thousand dollars a year would support a large and thriving section. The multiplication of sections and the gradual growth of the work would call for a larger income. A farm of ten large sections would require an endowment of a million, and it is easy to see room for many millions.

If the scheme here outlined approaches the ideal which science is waiting to see realized, it will be seen that the farm does not find its chief purpose in demonstrations of the truth of evolution or in testing the theory of natural selection. It is not a project designed simply to turn out curves and formulæ for the delectation of the knight-errants of statistical lore, nor is it the particular pet of any school or fad. Moreover, the prevailing idea that it has something in common with a zoological or botanical park rests on a total misapprehension. The organization, management and all the conditions obtaining in the public park are incongruous with those required for a research farm. Heterogeneous collections of animals, exhibited for the amusement of people, are wholly unsuited to the purposes of investigation in time, place and character. For the kind of work contemplated, the investigator must have forms of his own selection, collected, arranged and kept for his special purposes. He must have complete and permanent control of his quarters and the forms he is to study, and above all, *complete isolation from the public.* Only under such conditions could he have the unbroken quiet required in delicate observation, or expect natural behavior from the forms occupying his attention.

The farm project, let me say in conclusion, is one we cannot afford to see drawn away from Wood's Holl. It is an undertaking born and nurtured here, on a small scale to be sure, but still sufficient to give results and make clear the direct path to a large and most important development.

SUMMARY STATEMENT.

Laboratories.—The biological laboratories of to-day are almost exclusively devoted to the study of 'pickled' animals and plants. They have very few and inadequate facilities for the study of *living* organisms. This is a limitation for which no remedy has thus far been provided.

Field-work.—For the study of development, growth, life-histories, species, habits, instincts, intelligence, heredity, variation, adaptation, hybridisation, etc., we can depend neither upon the laboratory nor upon the field-work of naturalists. A world-wide field in which there can be no *control* of the forms to be studied, and no possibility of *continuity* in observation or opportunity for experiment, obviously does not meet the requirements of science.

Biological Farm.—The laboratory is too narrow, and the world too wide for the continuous study of living organisms, under conditions that can be definitely known and controlled. For such study, selected groups of organisms and a limited territory, with favorable conditions of land, water and food, are needed. Territory, living organisms and scientific staff would constitute a new plant, which might be called a *Biological Farm.*

Grounds.—The grounds of a biological farm would vary in extent with the growth of the work, from ten to a hundred or more acres. Land, woods, fresh-water ponds, sea-shore and islands would make a good combination.

Location.—The location of headquarters should be at a biological center, near laboratories drawing a large number of investigators, but at a safe distance from any large city or summer resort. These prime advantages of situation superadded to the exceptional natural advantages of available grounds are represented at Wood's Holl.

Natural Conditions.—A biological farm should include the largest possible diversity of natural conditions to insure wide freedom of development and opportunity for experimentation. *Water* is the first essential, and three forms of this element are needed, namely, sea-water, brackish water,

and fresh water. All three forms abound at Wood's Holl, and vicinity. The fresh-water ponds are numerous, and many of them, both on the mainland and on the neighboring islands, are *completely isolated* and stocked with forms in-bred for centuries. Brackish water in almost every degree, pure sea-water and tide-currents are right at hand.

Land is the next essential, and here we have hill, plain, marsh, swamp, shore and islands, and some of these islands are inimitable biological farms of nature's own make.

A seasonable range of temperature is essential to the existence of a majority of the forms best suited to cultivation and study; and in this are supplied very important conditions for experimental work. The surrounding sea protects Wood's Holl from extremes of heat and cold.

Isolation.—The most favorable combination of conditions may be utterly worthless, unless the farm can be made secure in its isolation from the public. Its work must go on in a *quiet environment*, where all the conditions are under control, and the investigator is free from the danger of intrusion.

Mode of Development.—The work should be developed slowly, section by section, each section consisting of a group of related species, or a single species, offering a wide range of problems.

Each section should be in charge of a director, prepared to continue the work during life, and supported by assistants and help for all routine and mechanical service. The staff would consist of directors, assistant investigators, artists, photographer, clerical help, keepers and a business manager.

Outlay and Maintenance.—The original outlay for land, stock, buildings, equipment, inclosures of land and water for isolation purposes, would vary according to the forms selected for study. From $50,000 to $100,000 would suffice for this. The maintenance of the first section, including salaries, accessions to stock, library, etc., may be estimated at $10,000 a year. The cost of additional sections would be about $5,000 each.

Ideal Center.—The association of three such institutions as the Marine Biological Laboratory, the U. S. Fish Commission Station, and a Biological Farm would form an ideal biological center. Each would help and be helped by the other two.

Cooperation.—There should undoubtedly be several biological farms in the country. The larger universities might well have their own farms, and thus very extensive and effective cooperative work be carried on.

Use to Science.—The farm would enable us to approach all the fundamental problems of life from the two sides of observation and experiment on living organisms. It would furnish material for study with precise records, and make it possible to keep up continuity in the experimental study of heredity and variation.

Practical Utility.—The utility of such work is seen when we reflect on the practical results already realized in the multiplication and improvement of domestic species of animals and plants through cross-breeding, hybridisation and selection. We have very meager and uncertain knowledge of the laws of heredity and variation—laws which underlie all progress of the race.

C. O. Whitman.

SCIENTIFIC LITERATURE.

Manual of Astronomy, a text-book. By Charles A. Young, Ph.D., LL.D. New York, Green & Company.

The preface to this volume informs us that it has been prepared in response to a rather pressing demand for a text-book intermediate

between the author's 'Elements of Astronomy' and his 'General Astronomy.'

It is perhaps an open question whether the fact that a text-book contains more matter than can be mastered in the time allotted to the subject constitutes a valid objection to its use, or a legitimate demand for a book of less dimensions. To bring home to the student in this practical way the fact that some things still remain to be learned undoubtedly has a salutary effect in some cases.

Be that as it may, we have here an excellent book. To those acquainted with the author's 'General Astronomy,' the pages present a familiar appearance, suggestive of a simple abridgment of the larger work. A more careful examination, however, shows that we have much more than this. No inconsiderable portion has been rewritten with the introduction of new matter and illustrations and all brought strictly up to date. We mention a few of the many cases in point. The very satisfactory account of the planet Eros; the reference to Belopolsky's spectroscopic researches on the rotation period of Venus; the application of the results of the investigations of Nichols, Hall and Lebedew on the repulsive action of the solar radiation to the formation of comets' tails, and the story of the Nova Persei.

If any mistakes or errors exist they have escaped the notice of the reviewer.

C. L. D.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

THE Ninth Summer Meeting of the American Mathematical Society was held at Northwestern University, Evanston, Ill., on Tuesday and Wednesday, September 2–3, 1902. About fifty persons were in attendance, including thirty-nine members of the Society. Two sessions were held on each day. The President of the Society, Professor Eliakim Hastings Moore, occupied the chair at the opening session, being succeeded by Professor T. S. Fiske and Professor H. S. White. The following persons were elected to membership in the Society: Professor T. J. I'a. Bromwich, Queen's College, Galway, Ireland; Mr. J. S. Brown, New York City; Professor G. C. Edwards, University of California, Berkeley, Cal. Eight applications for membership in the Society were received.

A committee consisting of Professors H. W. Tyler, T. S. Fiske, W. F. Osgood, J. W. A. Young and Alexander Ziwet was appointed to consider and report on standard definitions of requirements in mathematical subjects for admission to college and scientific schools. This committee will cooperate with those recently appointed by the National Educational Association and the Society for the Promotion of Engineering Education.

President Moore, Professor F. Morley and Dr. Emory McClintock were appointed a committee on the nomination of officers of the Society for the coming year.

The recently organized Pacific Section of the Society received the official designation of the 'San Francisco Section.'

Pleasant social features of the meeting were the dinner at Northwestern University on Tuesday evening and a gathering in Chicago on Wednesday evening. Resolutions appreciative of the hospitality of the University were adopted at the close of the meeting.

The scientific program comprised the following thirty-two papers:

(1) Dr. F. R. MOULTON: 'A method of constructing general expressions for the elements of the planetary orbits which are valid for a definite time.'

(2) Professor A. S. HATHAWAY: 'The quaternion treatment of the problem of three bodies.'

(3) Dr. J. V. COLLINS: 'A general notation for vector analysis.'

(4) Professor L. E. DICKSON: 'Definitions of a linear associative algebra by independent postulates.'

(5) Professor L. E. DICKSON: 'Two definitions of a field by independent postulates.'

(6) Dr. E. V. HUNTINGTON: 'Definitions of a field by sets of independent postulates.'

(7) Dr. OTTO DUNKEL: 'Regular singular points of a system of homogeneous linear differential equations of the first order.'

(8) Professor OSKAR BOLZA: 'Some instructive examples in the calculus of variations.'

(9) Professor J. B. SHAW: 'On linear associative algebras.'

(10) Dr. W. B. FITE: 'Concerning the commutator subgroups of groups whose orders are powers of primes.'

(11) Dr. J. W. YOUNG: 'On a certain group of linear substitutions and the functions belonging to it' (preliminary report).

(12) Professor JACOB WESTLUND: 'On the class number of the cyclotomic number field $k(e^{2\pi i/p^n})$.'

(13) Professor L. E. DICKSON: 'Announcement of new simple groups' (preliminary communication).

(14) Professor ALFRED LOEWY: 'Ueber die Reducibilität der Gruppen linearer homogener Substitutionen.'

(15) Professor H. S. WHITE: 'A special twisted cubic with rectilinear directrix.'

(16) Professor F. MORLEY: 'Orthocentric properties of the plane n-line.'

(17) Dr. VIRGIL SNYDER: 'Forms of sextic scrolls of genus greater than 1.'

(18) Professor PETER FIELD: 'Quintic curves for which $p=1$.'

(19) Dr. C. J. KEYSER: 'Concerning the line and plane geometries of point four-space, and allied theories.'

(20) Professor ARNOLD EMCH: 'A linkage for $u=e^{i\theta z}$.'

(21) Dr. EDWARD KASNER: 'The bilinear point-line connex in space; an extension of Clebsch's connex.'

(22) Mr. E. A. HOOK: 'Multiple points of Lissajous's curves in two and three dimensions.'

(23) Dr. L. P. EISENHART: 'Infinitesimal deformation of the skew helicoid.'

(24) Professor JOHN EIESLAND: 'Null systems in space of five dimensions.'

(25) Professor E. D. ROE: 'Note on a partial differential equation.'

(26) Dr. SAUL EPSTEEN: 'On integrability by quadratures.'

(27) Mr. W. B. FORD: 'On the possibility of differentiating term by term the developments for an arbitrary function of one real variable in terms of Bessel functions.'

(28) Professor T. F. HOLGATE: 'Apolar triads on a straight line and on a conic.'

(29) Professor H. B. NEWSON: 'List of continuous groups of collineations in space.'

(30) Miss HELEN BREWSTER: 'Group of collineations with invariant quadric surface.'

(31) Professor ALEXANDER PELL: 'On the generalized Beltrami problem.'

(32) Professor L. HEFFTER: 'Ueber die Curvenintegrale im m-dimensionalen Raum.'

The next meeting of the Society will be held at Columbia University, October 25.

F. N. COLE,
Secretary.

SOCIETY FOR THE PROMOTION OF AGRICULTURAL EDUCATION.

THE *Proceedings* of the 22d meeting of the Society, held in Pittsburgh, June 30 to July 2, 1902, is now in press and will contain the following papers: 'The Promotion of Agricultural Science,' by the President, Dr. W. H. Jordan, Director New York Experiment Station, Geneva, N. Y.; 'Notes on the Poisonous Plants of Nebraska,' Dr. C. E. Bessey; 'The Individuality of Plants an Important Factor in Plant Nutrition Studies,' Professor E. B. Voorhees; 'Some Soil Problems in the Dakotas,' Professor E. F. Ladd; 'The Results of Applying Crude Petroleum to Peach Trees in Ohio to Suppress San José Scale' (illustrated), F. M. Webster; 'The Available Energy in Timothy Hay' (illustrated), Dr. H. P. Armsby; 'The Composition of the Combustible Gases Excreted by Cattle,' J. A. Fries; 'The Statistics of the Dairy,' Maj. H. E. Alvord; 'The Æcidium as a Device to Restore Vigor to the Fungus,' Dr. J. C. Arthur; 'Crude Petroleum as an Insecticide,' Dr. E. P. Felt; 'Views of a Country Roadside' (illustrated), Dr. W. J. Beal; (1) 'The Use of the Centrifuge in Diagnosing Disease of the Cereal Grains,' (2) 'Preliminary Notes on a Continuous Process of Disinfecting Seed Grain with Formaldehyde Vapor' (illustrated), Professor H. L. Bolley; 'Some Variations in Introduced Garden Vegetables,' H. C. Irish; 'Plant Depredations and Plant Culture,' Professor F. W. Rane; 'The Mushrooms of Iowa, their Chemical Composition and Food Value,' Dr. J. B. Weems; 'Soil Bacteriology,' Professor F. B. Chester; 'The Relation of the Water Control of Certain Plants to their Hardiness,' Professor W. R. Lazenby; 'The Importance of Considering Previous Environment in Conducting Variety Tests,' Professor T. L. Lyon; 'Observation on Manure Sampling,' Dr. William Frear.

The next meeting of the society will be held in Washington, D. C., in connection with the American Association for the Advancement of Science, during the first week in January, 1903.

F. M. WEBSTER,
Secretary.

DISCUSSION AND CORRESPONDENCE.

'STRATIGRAPHY VERSUS PALEONTOLOGY IN NOVA SCOTIA.'

TO THE EDITOR OF SCIENCE: May I ask your space for a few words in reply to remarks by my friend Mr. David White on 'Stratigraphy *versus* Paleontology in Nova Scotia' (SCIENCE, August, 1902, page 232).

While I cannot pretend to the wide and varied acquaintance with the Paleozoic flora which he possesses, I may have a closer local knowledge of the conditions attending the occurrence of the floras that form the subject of his communication, than he has, and so be in a position to offer some suggestions that may have value in deciding the age of these floras.

I fully agree with him, however, in saying that a more thorough study of the paleontological question is desirable; but not in his claim that this will settle the question of age —*unless the stratigraphy is considered as well.*

As attention has lately been called to the remarkable resemblance of the fossil floras in certain basins in Nova Scotia and New Brunswick to those of the Coal Measures, and to each other, and arguments deduced from the Nova Scotia organic remains are applied to those in the neighboring province in assigning their age, we should not forget that there are very considerable differences both lithological and paleontological in the two districts and overlooking these tends to 'confuse the issue.'

The Nova Scotia deposits may or may not be of the same age as those in New Brunswick, but until there is a full agreement that they are contemporaneous, it seems unwise to apply arguments deduced from the former to fix the age of the latter. The basins are 150 to 200 miles apart.

At page 232 Mr. White gives a list of about a dozen reptiles, crustaceans and molluscs found in the Nova Scotian beds, which he claims are Carboniferous types. *Not one of these* except the worm, *Spirorbis eriensi,* has been found in the New Brunswick beds, and yet they are used (page 235) to show that the latter beds are Carboniferous. If Mr. White will reread my article to which he refers at page 234, he will find that it is based entirely on the New Brunswick beds, the flora of which was first described; and to which those of the neighboring province of Nova Scotia were referred, by Messrs. Fletcher and Ells, as to a standard.

Now if we take the evidence of the fauna actually found in the New Brunswick beds we find that it cuts the opposite way from that cited by Mr. White from the Nova Scotian beds. Of numerous insects and myriapods found in the New Brunswick (St. John) plant beds *none* are known in the Carboniferous. Of the forms referred to the Crustacea *all* are different from the Carboniferous forms, and the genera also differ. The two land molluscs are *unknown* in the Carboniferous.

That Carboniferous types of plants should be found as low down as the Devonian need not create surprise. Has not Walcott found Devonian fishes in the Silurian, and Silurian corals in the Ordovician?

We await the discovery in other parts of the world of plants in pre-Carboniferous strata which shall sustain Sir William Dawson's reference of the St. John plant beds to the Devonian, certainly the latest system to which they can be assigned. When Mr. White or some other geologist shall find in the wide domain of the United States, or some other part of the world, a Devonian of Silurian *lagoon* and *marsh* deposit, with plants, insects, myriapods, isopods, etc., of quite different type from those of the St. John plant beds, then we may consider whether the Canadian paleophytologists and stratigraphers have been at fault.

Mr. White refers, at page 235, to the 'thoroughly studied magnificent section of Devonian near the Gulf of St. Lawrence' as having no signs of 'the extraordinary paleontological anomaly' of the St. John plant beds. I fear that in this case he has not considered the importance of *habitat* in modifying the distribution of plants. Presuming that in the reference to a Devonian section he alludes to that at the head of the Baie Chaleur, the comparison is quite out of place; that was a lacustrine and estuarine deposit with fishes, etc., and some plants. It cannot be too

strongly stated that the plant remains at St. John are numerous and are in a marsh and lagoon deposit. The ecological conditions were different, and so are the plants. The Baie Chaleur beds hold very few species for comparison, and it is not surprising that most are different.

There is no 'isolated Carboniferous molluscan fauna' in the St. John plant beds, and to them therefore Mr. White's argument from this fauna does not apply.

As regards the *Megalopteris* argument, it has to my mind as much force now as before Mr. White's statement in this article that the genus is known to be only as old as the Pottsville. Professor Andrews shows it to have been only twenty or thirty feet above the lower Carboniferous limestone; and it did not spring, like Minerva, ready armed and helmed from the brain of Jove, *i. e.*, it had closely related ancestors of earlier date. And that author described several species, none of which is identical with Hartt's species of the St. John beds.

But, after all, paleontology must bow to stratigraphy, and until it can be shown that the geological structure at St. John has been wholly misunderstood and misinterpreted, this supposed anomaly of plants, generally considered as Carboniferous, occurring in beds as old at least as the Devonian Age, must remain.

G. F. Matthew.

St. John, N. B.,
September 11, 1902.

Evidence of Recent Elevation of the Gulf Coast along the Westward Extension of Florida.

To the Editor of Science: During the spring of the present year, while doing field work along the Gulf shore south of Tallahassee, Fla., I obtained some facts which seem to show perceptible elevation of the coast in that vicinity within the memory of man. The data upon which the following remarks are based were furnished by Mr. J. L. Oliver, of Wakulla, Florida.

At St. Marks, Wakulla Co., Fla., is an old store or warehouse formerly occupied by a Mr. Harrell. This old house is built on piles, and in the 'fifties' there was an old field with a little pond in it just north of the house. During the 'fifties,' except at neap tide, the water at high tide passed under this house and into the pond. Since that time the pond has been drained, so that now rain water never stands in it, and its present connection with the tides is less obstructed than in the 'fifties,' but, notwithstanding this, the water at spring tide no longer comes under the house or reaches the old site of the pond unless a strong southeast or south wind has been blowing for two or more days.

A neap tide overflows the banks of the St. Marks River only in low places, and an average tide will lack three hundred yards of reaching where the pond was. Brush is taking portions of the marsh, where it had never been known to grow before.

Mr. Oliver's estimate is that the land has been elevated from one foot to eighteen inches since the 'fifties.' At first I thought that filling in with sediment might cause the change of level, but that does not seem probable. Therefore, if this evidence is trustworthy, the Gulf coast in the vicinity of St. Marks, Fla., is rising at the rate of two to three feet per century.

These notes seem interesting, and it is hoped that they may incite others to make observations, or even lead to some attempts by establishing bench marks to measure the rate of change of level.

T. Wayland Vaughan.

Smithsonian Institution,
Washington, D. C.,
September 11, 1902.

The Strength of Ants.

To the Editor of Science: While walking on the university campus the other day, my attention was arrested by what appeared to be a grasshopper moving along the sidewalk without using his hind legs. Upon closer examination, I saw that the grasshopper was dead and was being dragged along by a small ant.

The difference between the size of the little laborer and his load was so extraordinary that I thought it might be of interest to know the exact weight of each. I accordingly weighed

them carefully on an analytical balance and obtained the following figures:

Weight of ant.....	3.2 mg.
Weight of grasshopper.....	190.0 mg.

Thus, the ant was dragging a load that weighed approximately sixty times his own weight. This is equivalent to a man whose weight is 150 lbs. *dragging* a load of 4½ tons, or a horse of 1,200 lbs., a load of 36 tons! Is this not somewhat remarkable?

ARMAND R. MILLER.

NAVAL ENGINEERING.

THE most extraordinary achievement in the domain of fast yacht or torpedo-boat construction has lately been reported as the outcome of Mr. Chas. D. Mosher's work in designing the high-speed steam-yacht, *Arrow,* for Mr. Chas. R. Flint, of New York. On the 7th of September this craft made a speed of *above 45 miles an hour* on the Hudson River, making the mile in less than one minute and twenty seconds. The measured mile was established by the Coast Survey, which sent its steamer *Bache* to fix its location some time since. This performance exceeds by three miles, nearly, that of the British torpedo-boat destroyer *Viper,* with engines of the Parsons type of steam-turbine. The latter made 42.25 miles an hour, a mile in one minute and twenty-five seconds. The *Arrow* is but 130 feet over all, 12 feet 6 inches beam, displacing 66 tons, on a draft of 4 feet 7 inches. The water-tube boilers contain 5,540 square feet of heating surface and the quadruple-expansion engines are capable of producing 4,000 horse-power. Maximum steam-pressure is reported to be 400 pounds at the boilers and 390 at the engines. The following table presents the records of recent fast craft of this type:

Boat.	Type.	Mile.	Knot.	Miles per Hour.	Knots per Hour.
Arrow.....	Yacht.....	1:19 9–10	1:32	45.06	39.13
Viper.....	English Torpedo Destroyer....	1:25	1:38	42.25	36.50
Turbinia.....	Yacht.....	1:28	1:44	40.00	34.50
Takou.....	French Torpedo Destroyer....	1:32	1:52	37.50	32.00
Taku.....	German Torpedo Destroyer...	1:32	1:52	37.50	32.00
Ellide.....	Yacht.....	1:34	1:55	36.50	31.00
Bailey.....	U. S. Torpedo Destroyer.....	1:40	2:00	35.00	30.00
Murakumo.....	Japanese Torpedo Destroyer..	1:40	2:00	35.00	30.00

CONSUL J. E. KEHL sends to the Department of State, from Stettin, a description of the new North German Lloyd steamship *Kaiser Wilhelm II.,* recently launched at the Vulcan yards in that city. The cost was 16,000,000 marks, and she is scheduled to sail during the early part of April, 1903, between Bremen and New York. He says: The *Kaiser Wilhelm II.* is built according to the German Lloyd requirements for the highest register of the four-deck ship class. Her double bottom is divided into 26 water-tight compartments, while the hull proper is divided by 17 bulkheads into 19 water-tight compartments, each compartment having separate outlets to the promenade decks. Her 17 pumps are said to be capable of discharging 9,360 tons of water per hour. The construction of the stern is very similar to that of *Kaiser Wilhelm der Grosse,* excepting that the plating below the water line, inclosing the screw shafts, and above the rudder is cigar-shaped, leaving a large arched space on each side between the center line and screw shafts, running forward and gradually tapering for a distance of about 25 feet into the common hull shape. This has been done in accordance with the requirements of the German Admiralty, at whose disposal the ship will be placed in the event of war.

There are 4 sets of 4-cylinder expansion vertical engines, with surface condensers, each set working on 3 cranks, 2 sets for each propeller shaft. The engines are balanced after Mr. Schlick's patent and will indicate altogether 38,000 to 40,000 horse-power. They are set up in pairs, one behind the other, so as to bring a water-tight bulkhead between each pair, thereby increasing the safety of the vessel. The steam will be produced by 12 double-end and 7 single-end boilers, which will

Name of Ship.	Date.	Length over all	Beam.	Depth.	Draft.	Displacement.	Speed.
		Feet.	*Feet.*	*Feet.*	*Feet.*	*Tons.*	*Knots.*
Great Eastern	1858	692	83	57½	25½	27,000	14.5
Paris	1888	560	63	42	26½	15,000	20.5
Lucania	1893	620	65	43	28	19,000	22.1
Kaiser Wilhelm der Grosse	1897	649	66	43	29	20.000	23
Oceanic	1899	704	68	49	32½	28,500	20.7
Deutschland	1900	684	67	44	30	23,200	23.5
Kronprinz Wilhelm	1901	663	64	43	30	21,280	23.53
Celtic	1901	700	75	49	36½	37,700	16
Kaiser Wilhelm II	1902	706½	72	52½	.....	26,000	*23

work at 225 pounds per square-inch pressure. The ship's accommodations are for 775 first-cabin passengers, 343 second-class passengers, and 770 steerage passengers. It may be interesting in this connection to give dimensions of existing leviathans, to afford comparison with the *Kaiser Wilhelm II.;* also to note the size of the famous *Great Eastern,* now broken up.

SCIENTIFIC NOTES AND NEWS.

Sir Norman Lockyer has been elected president of the British Association for 1894, when the meeting will be held at Cambridge. The meeting next year, as already announced, will be held at Southport.

Professor W. H. Welch, of the Johns Hopkins University, sailed last week for England where he delivers the Huxley lecture before the Charing Cross Hospital on October first.

Lieutenant Robert E. Peary, on the *Windward,* arrived at Nova Scotia on September 18, and Captain O. N. Sverdrup, on the *Fram,* arrived in Norway on September 19. Both expeditions doubtless accomplished valuable work for geography, natural history and ethnology, the results of which will be subsequently published. The *Fram* had a corps of scientific observers, consisting of Naval Lieut. Victor Baumann (astronomer), Lieut. G. Y. Ysachsen (cartographer), Dr. Svendsen (meteorologist), Dr. Bay (zoologist), Dr. Herman G. Simmons (botanist), and Dr. P. Schel (geologist).

Professor Angelo Heilprin has returned to Philadelphia from Martinique, having been on Mount Pelee on the afternoon of the recent eruption. This occurred at 9:10 in the evening, and the area of destruction was much greater than in the eruption of May 8.

Professor Arthur Michael, who has been making a tour of the world during the past year, will resume the duties of the chair of chemistry at Tufts College at the opening of the college year.

Dr. Jacques Loeb, professor of physiology at the University of Chicago, is at present in San Francisco. It is said that he is still considering the call he recently received to the University of California.

Professor F. Haber, of the Institute of Technology, Karlsruhe, and Professor R. S. Hutton, of Owens College, Manchester, are visiting this country to study the electrochemical industries.

The German commissioner, Captain Hermann, has reached Europe, bringing with him a large amount of new material for the mapping of the Kivu region.

For the study of the density of the earth, President F. W. McNair, of the Michigan College of Mines, and Dr. John F. Hayford, chief of the computing department of the United States Coast and Geodetic Survey, are conducting experiments at the Tamarack mine, near Calumet.

Professor Theodore Boveri, of Würzburg, has received the Stiebel prize of the Sencken-

* Contract calls for no less than 23 knots, like the *Kronprinz* and *Deutschland,* which do almost 1 knot better than their contract. It is confidently expected that the *Kaiser Wilhelm II* will break all records by going 24 knots and possibly more.

berg foundation for his work 'Ueber die Natur der Centrosomen.'

LYMAN B. STOOKEY, Ph.D. (Yale), has been appointed assistant in physiological chemistry in the laboratory of the N. Y. State Pathological Institute at Ward's Island, New York City.

RAYMOND A. PEARSON, for the past seven years assistant chief of the dairy division of the U. S. Department of Agriculture, has left that position to enter upon scientific commercial dairy work in New York City and Philadelphia.

A COMMITTEE has been appointed at Dôle, where a statue of Pasteur has recently been erected, to collect funds to purchase the house in which he was born, as a permanent memorial.

M. BOUCHARD delivered a eulogy on the late Professor Virchow at the Paris Academy of Sciences on September 9.

THE funeral of Sir Frederick Abel took place on Sept. 11. The London *Times* states that many of the scientific societies and public institutions with which he was connected were represented. The Imperial Institute was represented by Sir Stewart Bayley, Colonel Makins, Professor Wyndham Dunstan, F.R.S., the director of the scientific department, and Lieutenant G. R. Maltby, assistant secretary; the Royal Society by Sir W. Huggins, the president, and Mr. A. B. Kempe, the treasurer; the Senate of the University of London by the Rev. Dr. Robertson, the vice-chancellor, and Professor Silvanus Thompson, F.R.S.; the Chemical Society by Professor H. McLeod, F.R.S., and Dr. A. Scott, F.R.S., hon. secretaries; the Board of Trade by Mr. Llewellyn Smith; the Athenæum Club by Mr. H. R. Tedder, the secretary; and the Goldsmiths' Company by Mr. R. Montagu Tabor, the prime warden, and Sir Walter Prideaux, the clerk.

THE civil service commission announces examinations as follows: on October 21, inspector of textile fabrics, in the New York Navy Yard, at a salary of $1,252; on October 18, geometrical lathe operator in the Bureau of Engraving and Printing, at a salary of $1,500; on November 1, scientific aid in the Bureau of Forestry and Bureau of Agriculture in the Philippine Service, at salaries of $300 and $480 respectively; on November 4, for preparator in the Division of Insects, U. S. National Museum, at a salary of $480; on November 11, for forestry inspectors in the Philippine service, it being wished to fill two positions, one at a salary of $800 and one at a salary of $1,200.

WE have already called attention to the International Congress of Plant Breeding and Hybridization which will be held under the auspices of the Horticultural Society of New York, on September 30 and October 1 and 2. The sessions will open at 10 A.M. and 3 P.M. and will be in the rooms of the American Institute, 19 West 44th St. The program contains the titles of 61 papers, many of which are of great scientific interest.

THE Tenth National Irrigation Congress will be held at Colorado Springs from the sixth to the ninth of October. The National Association of Irrigation Engineers will meet at the same time and place.

THE International Mining Congress met at Butte, Mont., from September 1 to 5, under the presidency of Mr. E. L. Schaffner, of Cleveland. Resolutions were adopted advocating a government department of mines and mining with a cabinet officer. The congress, which will hereafter be known as the American Mining Congress, will meet a year hence at Deadwood, S. Dakota.

THE fifth International Congress for Applied Chemistry will be held in Berlin from June 2 to 8, 1903. The honorary president is Professor A. Winkler; the president, Professor O. N. Witt; and the secretary, Dr. G. Pulvermacher, Marchstrasse 21, Charlottenburg.

WE learn from *Electrochemical Industry* that an informal meeting to discuss a British Electrochemical Society was held on March 4, 1902, at which a committee consisting of the following gentlemen was chosen to consider the subject: J. Swinburne (the present president of the British Institution of Electrical Engineers), Dr. F. M. Perkin, Dr. Don-

nan, W. R. Cooper, S. Cowper-Coles and H. V. Simpson. This committee has held meetings from time to time at which the best methods of procedure have been discussed. The question of working in conjunction with one of the existing societies has been considered, and several societies have been approached on the matter, but the committee takes the view that such an arrangement is not likely, at any rate for the present, to have the desired effect. Steps in the direction of organizing an independent society have therefore just been taken.

The season at the Minnesota Seaside Station on the Straits of Juan de Fuca was brought successfully to a close late in August. Thirty-eight botanists and zoologists were in attendance, only four of whom were from the Pacific slope. A new laboratory building, 24 x 40 feet, two stories high, was opened and this afforded space for the work in advanced and elementary botany. The old laboratory was devoted to the department of zoology. Courses, with lectures, laboratory and field work, were conducted by Professors Conway MacMillan and Raymond Osburn, and by Miss Josephine E. Tilden. Out-door lectures on plant and animal ecology, given in the forest and on the shore, were a feature of the season.

Professor Lannelongue, of Paris, has presented $7,500 to the Paris Académie de Médecine for the endowment of a triennial prize.

Mr. James N. Jarvie, who has erected a library building for Bloomfield, N. J., at a cost of $100,000, has added an endowment fund of $50,000.

A press dispatch from Alexandria says the total number of fresh cholera cases in Egypt in the week just ended was 6,587. There were 5,983 deaths. In the previous week there were 9,805 fresh cases and 8,497 deaths. Since the commencement of the epidemic, July 15, to the present time there have been 30,931 cases and 25,734 deaths.

A Reuter telegram from Rome states that the Italian postal authorities have examined a scheme submitted by an engineer, named Piscicelli, for the establishment of an electric postal service. It is proposed, by means of this system, to transmit letters in aluminium boxes, traveling along overhead wires at the rate of 400 kilometers an hour. A letter could thus be sent from Rome to Naples in 25 minutes and from Rome to Paris in five hours. Signor Galimberti has appointed a technical commission to report on the system before instituting a series of experiments between Rome and Naples.

The Scottish National Antarctic expedition, under the leadership of Mr. William S. Bruce, will sail for the Antarctic regions on the *Scotia* early in October.

The managing director of Marconi's Wireless Telegraph Co., writes to the London *Times* that Mr. Marconi, who left England on August 23 on the *Carlo Alberto*, the flagship of the Italian Navy, has been in daily communication by wireless telegraphy with their long-distance station at Poldhu, Cornwall. They have received from him from Spezia a telegram in which he says that he has received perfect messages direct from Poldhu inside Gibraltar Harbor, and throughout the entire course of the Mediterranean tour. A reference to the map of Europe shows that the messages must have passed across the Bay of Biscay and Spain, across France, and across the Alps. Telegrams for the King of Italy and the Italian Minister of Marine have been sent from Poldhu and correctly received on the tape of the wireless telegraph receiving apparatus on the *Carlo Alberto* in Spezia harbor. Mr. Marconi has been commanded to visit the King of Italy, and has been informed by the Italian Minister of Marine that the *Carlo Alberto* is at his disposal for taking part at once in a transatlantic test of long-distance stations. The ship will, therefore, take him to Cape Breton, where the Canadian station for transatlantic telegraphy is installed, and subsequently to the long-distance station installed on Cape Cod, and now owned by the Marconi Wireless Telegraph Company of America.

The British Sanitary Institute opened its annual congress in Manchester on Sept. 9, with two thousand delegates in attendance. The president, Lord Egerton, said in his ad-

dress, according to the report in the London *Times*, that he could only speak as a landowner in a populous district and as one responsible for dealing with the dwellings of the poor and the buildings on his estate connected with the farms, and as one who had taken an humble part in the various legislative measures which had been passed to improve the sanitary condition of our towns and the health of the people during the last 40 years. He could certify to the great sanitary improvements which had been made in the cottages, farms and farm buildings in his recollection, and in the water supply of our country districts. Yet they had been hardly sufficiently alive to the storage of rain water. The sanitary authorities still kept a watchful eye on the necessary supply of fresh air to their agricultural buildings, the cubical contents of their cow-houses, and the supply of pure milk. He proceeded to refer to the efforts made to purify the rivers, mentioning in particular the work of the Mersey and Irwell Joint Committee. They had in that great city of Manchester triumphs of engineering and mechanical art applied to various industries, but the population which inhabited it had, as in other large towns, degenerated in size and physical power from the ancestor or progenitor who was attracted into the town by higher wages from the country districts. The same process was still going on, the large percentage of rejections from physical disabilities among those who offered themselves as recruits even in Manchester itself giving an alarming proof of the degeneracy of the town population. One of their great problems was to arrest this deterioration and to make up for the necessary drawbacks of town life by greater care in the physical education of the young and in teaching them the principles of hygiene or the preservation of health. Though it was given to many of no great physical strength to succeed in the race of life and by sheer brain power to triumph over physical weakness, yet in most cases a strong physical frame was necessary to supplement the endowment of the mind in most of the careers open to man. This brought him to the question of the need for physical training. He agreed with Lord Meath, in the address which he recently delivered in Manchester, as to the introduction of physical exercise in our elementary schools as the best way of improving the physical and moral training of our youth.

THE Ohio State Board of Health is this season continuing the investigation of the pollution of the important streams of the State. The Geological Survey is cooperating with the State Board of Health by measuring the flow of the rivers under investigation. The work is one of particular importance on account of the large number of towns which use water for municipal supply from streams already polluted by the sewage and manufacturing refuse of cities located at higher points upon them. Problems of this nature are being presented to all of the central western states, but the Ohio State Board of Health has taken the lead in the investigation of its polluted streams, and is taking preliminary steps to do away with this menace to the public health. Among the more important rivers under investigation are the Sandusky, Maumee, Scioto and Olentangy. In addition to these a number of smaller streams whose waters are now used, or may soon be used, for municipal purposes will also receive investigation.

IN his report on the production of coal in 1901, now in press, in Mineral Resources of the United States, 1901, U. S. Geological Survey, Mr. E. W. Parker presents the statistics of fatal and non-fatal accidents which occurred in the process of mining coal in eighteen states and territories during 1901. In these eighteen states and territories the total number of lives lost in 1901 was 1,467, and the total number of men injured was 3,643. The number of tons of coal mined for each life lost varied from 426,094 in Maryland to 49,424 in Indian Territory. The average number of tons mined for each of the 1,467 lives lost in these eighteen states and territories was 188,668. It is interesting to note that in Pennsylvania the number of tons of bituminous coal mined per life lost was a little more than double the amount mined per life lost in the anthracite mines in the same state. Maryland enjoys the distinction of the largest

tonnage per life lost, while the Indian Territory has the largest percentage of deaths for the tonnage mined. The total number of men employed in the coal mines of the United States in 1901 was 485,544, who made an average of 216 working days, as compared with 448,581 men, with an average of 212 working days, in 1900. The distribution of this labor in 1901 was as follows: In the anthracite mines, 145,309 men, with an average working time of 196 days; in the bituminous mines, 340,235 men, with an average working time of 235 days.

Forestry and Irrigation gives details in regard to the seven new forest reserves which have been established recently by presidential proclamation. These include three new reserves in Arizona: The Mount Graham Forest Reserve, 118,600 acres in extent, located in Graham county; the Santa Catalina Forest Reserve of 155,520 acres, in Pima county, and the Chiricahua Forest Reserve, in Cochise county, of 169,600 acres in extent. In Montana two new reserves, the Madison Forest Reserve of 736,000 acres and the Little Belt Mountains Forest Reserve of 501,000 acres, have been established. The first-named reserve is in Madison and Gallatin counties, bordering on the western side of the Yellowstone National Park. The Little Belt Reserve is located in Meagher and Fergus counties. A large new reserve has also been set apart in New Mexico, to be known as the Lincoln Forest Reserve. It is 500,000 acres in extent and is located in Lincoln county. An unusually large reserve has just been set aside in Alaska, to be known as the Alexandria Archipelago Forest Reserve; it contains 4,506,240 acres. In addition to the foregoing new reserves, a number of changes have been made in the reserves already established. Lands have been added on the eastern side of the Yellowstone Forest Reserve, increasing its area by 24,960 acres. The Medicine Bow Forest Reserve, in Wyoming, has had recent additions made to the amount of 20,533 acres. The White River Reserve, in Colorado, has been decreased in area by 68,160 acres along the headwaters of the White and Yampa Rivers. The Crater Lake National Park of 164,560 acres, which was established by Congress at its last session, reduces the size of the Cascade Forest Reserve, in Oregon, by 152,680 acres. The total area of all the forest reserves is now 58,850,925 acres. It is interesting to note that the total area of the United States, exclusive of island possessions, is 2,362,960,000 acres. Thus it will be seen that the forest reserves now amount to about one fortieth of the entire area of the United States. In square miles the area of the reserves is 91,954, or almost twice the size of Pennsylvania.

UNIVERSITY AND EDUCATIONAL NEWS.

A Reuter telegram, states that, as the result of the investigations of a party of British educationalists who have been making inquiries in Canada, it has been decided to establish a training farm in connection with Berkhampstead School. A site has been selected between Calgarry and Edmonton, in western Canada. Upon its success depends the opening of several other farms where British youths will receive training.

Professor R. S. Shaw, son of Professor Thomas Shaw, of the Minnesota College of Agriculture, has been elected professor of agriculture of the Michigan Agricultural College. Professor Shaw has been professor of agriculture in Montana.

Mr. Raymond Burnham, graduated from Cornell University in '97, has been appointed professor of experimental engineering at the Armour Institute, Chicago. He is the son of the well-known astronomer, Professor S. W. Burnham.

Dr. F. H. Safford, formerly instructor in Harvard University and assistant professor in the University of Cincinnati, has been appointed instructor in mathematics in the University of Pennsylvania.

Dr. Willy Wien, of Würzburg, has been called to the chair of physics at Leipzig, to succeed Professor Ludwig Boltzmann.

Dr. O. Schmidt, professor of chemistry at Stuttgart, has retired.